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Low-Energy Physics from a High-Energy Standpoint

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THE title of this article was suggested by the title of a three-volume work first published nearly 50 years ago by Felix Klein: *Elementary Mathematics from an Advanced Standpoint*. The object of Klein's work was to point out the relationships among problems that arise in different fields of mathematics and, in particular, to show how more advanced mathematical concepts could bring added insight to the teaching of elementary mathematics in the secondary schools. Needless to say, I do not mean to imply by the similarity of titles that low-energy physics is elementary in character or that high-energy physics is advanced; I mean simply that there are differences in approach. More important, since both types of physics deal with the same basic material, atomic nuclei and their constituents, relationships can be expected between problems that arise in the two fields. In short, experiments in high-energy physics can throw a good deal of light on the low-energy properties of nuclei: their ground and low-lying excited states.

High-energy experiments generally make use of nucleons, pions, muons, electrons, or photons. For the purpose of the present discussion (*1*), such experiments can be divided into two classes: those in which a large amount of energy is transferred to the target nucleus, and those in which the nucleus is left in its ground state or a low-lying excited state. It is possible in principle to learn a good deal about the nuclear ground state from the first class of experiments, but it is usually difficult in practice, for a transition from the ground state to a highly excited state is involved, and the properties of the final state are generally not well understood. In this class belong strongly inelastic scattering experiments and absorption experiments in which pions or high-energy photons disappear.

Perhaps the simplest of these experiments to interpret is photodisintegration without meson production. A reasonable model for this process has been proposed by Levinger (*2*), according to which the photon is absorbed by a pair of nucleons within the nucleus. In this model, the ground state of the nucleus is characterized in first approximation by a nucleon momentum distribution, and the electromagnetic transition carries two interacting nucleons from a low-energy state to a high-energy state in which they may escape from the rest of the nucleus. The interaction of the nucleons with each other is important, for this means that the wave function for the relative motion of the two nucleons appears in an essential way. Another way of putting this is to say that not only does the single-nucleon distribution function enter, but the two-nucleon correlation function is also of importance. A quantitative calculation along these lines, made by Dedrick (*3*), shows surprisingly good agreement with recent experiments of Johansson (*4*). Perhaps the main conclusion that can be drawn from this agreement is that correlations of three or more nucleons are not of dominant importance in the ground-state wave function. The same conclusion has been reached by Levinson (*5*) from a study of configuration mixing in nuclei with doubly magic plus three nucleons.

Most other experiments of the first class involve additional unknown factors that complicate their interpretation, such as pion-nucleon scattering cross sections or pion production cross sections. However, some high-energy processes that involve only nucleons can be handled in similar fashion to the photoeffect. An example is the pickup process, first discussed by Chew and Goldberger (*6*).

Experiments in the second class, those in which a relatively small amount of energy is transferred to the target nucleus, are easiest to interpret in terms of the properties of the nuclear states when the interaction with the incident particle is known and is weak. The reason for the first qualification is apparent, for the number of unknown parameters is thereby reduced. It means that the situation is more favorable for muons, electrons, and photons than for nucleons and pions, since for practical purposes the interaction is then entirely electromagnetic and hence known. The existence of an anomalous muon-nucleon interaction comparable in strength with the electromagnetic interaction would probably be inconsistent with the measurements of Fitch and Rainwater (*7*) on the spectra of mu-mesic atoms. Experiments on the nuclear scattering of cosmic-ray muons, by Amaldi and Fidecaro (*8*) and by Rochester and Wolfendale (*9*), and measurements of muon pair production by photons, performed by Masek, Lazarus, and Panofsky (*10*), are in general agreement with this conclusion.

It is also desirable that the interaction between incident particle and target nucleus be weak. This greatly simplifies any calculations that are made, for perturbation methods can then be used. It also means that higher-order processes, which involve virtual intermediate states of the nucleus, do not play an important part. Since some of these states will have

high energy, their appearance would make it impossible to interpret the experimental results entirely in terms of the low-lying initial and final nuclear states. This criterion of weak interaction also favors muons, electrons, and photons as compared with nucleons and pions.

In spite of this it can be seen that photons are not suitable for experiments of the second class. Either a high-energy photon is absorbed, in which case the final nuclear state has high energy, or it is scattered, in which case some intermediate states of high energy appear, because of the virtual absorption and reemission of the photon. If these intermediate states correspond to high excitation of the nucleus, the experiments again cannot be interpreted entirely in terms of low-lying states; this represents the effect of nuclear dispersion. If on the other hand the intermediate states correspond to virtual electron-positron pairs, only the static charge distribution of the nucleus enters. This is Delbrück scattering, which therefore can in principle furnish information about the nuclear ground state, but in practice is too weak to be useful in this connection (*11*).

The foregoing discussion leaves muons and electrons as the two products of high-energy physics that are most likely to be useful in the study of the low-energy properties of nuclei. Thus far, muons have been available at rather low energies as decay products of pions produced with high-energy accelerators, and at high energies in cosmic radiation. The low intensity and wide energy distribution of the latter have so far made precision scattering experiments with cosmic-ray muons impossible. The accurate mumesic atom spectra obtained by Fitch and Rainwater (*7*) have on the other hand provided reliable values for the mean-square radius of the nuclear charge distribution. The possibility of obtaining such information was pointed out by Wheeler (*12*), and experiments of this type were first performed by Chang (*13*). Nuclear radii obtained in this way rest on interpretations of the experimental data by Cooper and Henley (*14*) and by Hill and Ford (*15*). More detailed information concerning the shape of the charge distribution cannot be obtained without high-energy, well-collimated, monoergic muon beams, which so far do not exist. However, the fine structure of the mumesic atom spectra can be used to infer the structure of the low-lying nuclear rotational states, as has been pointed out by Wilets (*16*) and by Jacobsohn (17). Further, the capture of negative muons by nuclei, measured by Keuffel (*18*), does not leave the final nucleus with very high energy, for most of the energy is carried off by the neutrino. Then, as is shown by Primakoff (*19*), the rate of capture can be expressed in terms of the proton density and correlation function for the ground state.

Electrons are now available in well-collimated, monoergic beams with energies up to 630 Mev, almost completely free of background radiation of other kinds (*20*). Their interaction with nuclear matter is known to be electromagnetic and, hence, is reasonably weak. Elastic scattering of electrons provides direct information on the ground-state nuclear charge distribution, and inelastic scattering data can be analyzed to yield information on nuclear excited states. Since the effects produced by high-energy electrons are often discussed in terms of the method of virtual quanta, it is worth pointing out the limitations of this concept. A charged particle in the extreme relativistic region has its coulomb field contracted to a narrow sheet that is perpendicular to the line of motion. The electric field vector is radially out from this line, and the magnetic field vector associated with the motion of the charge is also in the sheet and tangential to a circle centered on the charge. The two field vectors are nearly equal in magnitude, so that together they are represented to good approximation by a transverse light pulse that travels along with the charge. This pulse may then be Fourier-analyzed into virtual quanta, which cause effects like any other photons in the same frequency range. The principal limitation of this picture is that it represents undisturbed motion of the electron. As long as the electron is scattered through a very small angle with very little energy loss, the method of virtual quanta can be used. Such events comprise the overwhelming bulk of the scattering processes but give little more information than can be obtained from experiments with low-energy photons.

More distinctive data are obtained from the relatively few events in which the electron is scattered through a large angle. It is better to think of these processes in terms of the Møller fields (*21*), which do not have the transverse character of the virtual quanta and, hence, are not even approximately representable as photons. Unlike photons, for which the energy is always equal to the momentum multiplied by the speed of light, the Møller fields can transfer large amounts of momentum and small amounts of energy from the electron to the nucleus. The momentum is simply the vector difference between the initial and final electron momenta and, hence, is large when a high-energy electron is scattered through a large angle. The energy depends on the particular nuclear transition and can be anything from zero, for elastic scattering, up to the initial electron energy. The inherent advantage of large momentum transfer is that the wavelength associated with the Møller fields is short, so that small-scale details of the nuclear structure can be mapped out. At the same time the energy transfer can be small, so that only low-lying nuclear states are involved.

Elastic electron scattering experiments of Lyman, Hanson, and Scott (*22*) at 16 Mev were the first to give some indication that the nuclear charge distribution has a somewhat smaller radius than the specifically nuclear force field. Other experiments at moderate energies, mainly by Pidd, Hammer, and Raka (*23*), and the high-energy experiments between 80 and 200 Mev, by Hofstadter and collaborators (*24, 25*),

have abundantly confirmed this indication. In order to take full advantage of high-energy electrons, it is essential to have good energy and angle resolution of both the incident and scattered electrons: well-collimated and monoergic incident beams and careful magnetic analysis of the electrons scattered at several well-defined angles. Elastic scattering experiments by Hofstadter, McIntyre, Fechter, Knudsen, and Hahn (*24, 25*) on a number of elements have been interpreted in terms of static, spherically symmetric charge distributions by Yennie, Ravenhall, and Wilson (*26*), by Brown and Elton (*27*), and by Hill, Freeman, and Ford (*28*). Experimental results for a wide range of energies and angles and for the larger atomic numbers lead to nuclear charge distributions that are uniform in the central region and taper to zero over a surface layer about 2×10^{-13} cm thick and that have the same root-mean-square radius as a uniformly charged sphere of approximate radius 1.20×10^{-13} $A^{1/3}$ cm. Similar experiments in hydrogen by Hofstadter and McAllister (*29*) indicate a finite electromagnetic size for the proton. It is expected that with sufficient experimental accuracy it will be possible to assign sizes separately to the distributions of charge and of magnetic moment of the proton.

There are several respects in which a nucleus differs from the static, spherically symmetric charge distribution mentioned previously. Nuclei that possess electromagnetic multipole moments are not spherically symmetric. In the heavier nuclei, the most important of these moments is the electric quadrupole moment. According to the theory of Bohr and Mottelson (*30*), a nucleus can have an intrinsic angular deformation of shape and still have zero angular momentum in its ground state, and indeed this occurs for many even-even nuclei. Then the nucleus has no quadrupole moment in its ground state and therefore gives no indication of its deformation in its optical atomic spectrum. In such a case, the deformation does not show up in the truly elastic electron scattering either. However, it gives rise to a set of low-lying nuclear rotational states with excitation energies of the order of a few hundreds of kilovolts. With energy resolution in the scattering experiments of the order of ¼ percent—500 kev out of 200 Mev—inelastic scattering to these levels often cannot be distinguished from elastic scattering.

A general theory of inelastic scattering caused by arbitrary nuclear multipole transitions has been given (*31*). An interesting special result of this theory concerns the total scattering caused by the nuclear deformation, in addition to that caused by the spherical charge distribution. This includes additional elastic scattering when the ground state has spin one or greater and also inelastic scattering to the lowest rotational states. The sum of these depends only on the intrinsic deformation and not on the ground-state spin. A specific calculation of this effect has been made by Downs, Ravenhall, and Yennie (*32*) for 180-Mev electrons scattered by tantalum, for comparison with the experiments of Hahn and Hofstadter (*33*). The experimental scattering curve is much smoother than that for gold or lead, both of which have small deformations. It cannot be fitted with a spherically symmetric charge distribution of the type mentioned previously. The fitting procedure is as follows. The general slope of the experimental curve fixes the root-mean-square radius of the charge distribution. The surface layer thickness is then chosen to give the best detailed fit, in which case the theoretical curve is too low in the neighborhood of 70°. This minimum, as well as another near 110° that is beyond the range of the experiments, is then filled in by the deformation contribution to the scattering; this gives an estimate for the deformation that is in good agreement with that obtained from Coulomb excitation experiments. Finally, it is recognized that the surface thickness obtained in this way is greater than the true surface thickness, because of the averaging of the deformed nucleus over angles to obtain the spherically symmetric part of the charge distribution. The corrected root-mean-square radius and surface thickness are then in good agreement with the corresponding values for gold.

As I have just pointed out, a nucleus departs from the simple model of a static, spherically symmetric charge distribution in that it is not always spherically symmetric. It is also not static, for it has internal degrees of freedom. These manifest themselves in an infinite set of excited states, which appear as virtual intermediate states in any scattering process, even though the initial and final nuclear states have low energy. This nuclear dispersion contribution to electron scattering would, of course, be very small in comparison with the first-order scattering calculated from the Møller fields if the interaction between electron and nucleus were very small. The actual electromagnetic interaction is of such magnitude that the dispersion contribution is relatively small in a number of interesting cases but is not negligible. A calculation indicates that most of the effect comes from terms in which the intermediate state is either the initial or the final nuclear state (*34*). When this is the case, it is expected that the bulk of the dispersion contribution can be included by using initial and final electron wave functions that are exact solutions in the static Coulomb field of the nucleus.

Still another way in which the real nucleus departs from its simple model is in the expected correlations between positions of nucleons. This short-range order within the nucleus, at least insofar as it refers to the protons, should give the charge distribution a granular structure. Because of the small dimensions of this granularity, short wavelengths are required for its investigation, probably such as those that correspond to the large-angle scattering of 400-Mev electrons.

The three examples just discussed—deformation of shape, dispersion effects, and granularity—point to the importance of having available exact solutions of the Dirac equation for static, spherically symmetric

nuclei. In this way the principal effect of the nucleus on the scattered electron is taken into account, and one can hope to treat the other effects as relatively small perturbations. However, an exact solution in the form of a series of a large number of partial waves is a very cumbersome thing with which to work. It is therefore of great importance for further work along these lines that Yennie found that the exact solution can be represented to good approximation, in the immediate neighborhood of the nucleus, by a plane wave with altered parameters (*35*). This arises because the scattering phase shifts are nearly constant; moreover, the plane wave can be modified to take account of a linear dependence of the phase shifts on angular momentum, which is a better representation of the actual situation. It is in this way that the afore-mentioned quadrupole effects in tantalum were calculated.

One of the side effects that can complicate the interpretation of electron-scattering data is the emission of radiation, or *bremsstrahlung*. This is particularly important for elastic or nearly elastic scattering, since large numbers of soft photons are expected. This radiative correction to scattering was first calculated by Schwinger (*36*) under the assumption that the scattering potential is weak enough to be treated by first Born approximation. Recently, Suura (*37*) has shown that the fractional radiative correction at high energy—the ratio of the actual cross section to that computed with neglect of radiation—is the same as that found by Schwinger. This turns out to be rather small in comparison with the absolute accuracy of the experiments and also not to be a rapidly varying function of energy or angle, so that it does not distort the experimental results appreciably.

As a final example of a bit of low-energy physics information that has been obtained only from experiments at high energies, I shall discuss briefly the electric monopole transition in carbon-12 (*38*). The ground state of this nucleus has zero total angular momentum and even parity, and it is believed that the second excited state, at 7.68 Mev, is also 0^+. This state has been excited by Fregeau and Hofstadter (*39*) by means of inelastic scattering of 190-Mev electrons, and an angular distribution has been obtained.

The electric monopole matrix element that corresponds to this transition between 0^+ states can be inferred from suitable plots of the experimental results against the momentum transfer. These plots are consistent with an assumed matrix element of 4.0×10^{-26} cm^2. It is interesting that this value happens to be about the same as that found by Devons, Goldring, and Lindsey (*40*) for the transition between the ground state and the first excited state at 6.06 Mev in oxygen-16, which is also an electric monopole transition. The latter experiment measured the half-life of the excited state for pair emission, which is possible only if the upper state is the first excited state, since otherwise the rate of cascade gamma radiation greatly exceeds the rate of pair emission. This low-energy physics approach cannot, therefore, be used in the case of carbon, where the second excited state is involved.

Further, Coulomb excitation by positive ions, which cannot in any event be used on a monopole transition, is not very effective in dealing with light elements that have widely spaced energy levels, because of barrier penetration. In such situations, high-energy physics not only makes possible determination of the rates of low-energy processes but can in principle provide detailed information on the radial dependence of the pertinent matrix elements.

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Science and Statecraft*

W. Sterling Cole

House of Representatives, United States Congress

A generation ago, the scientific laboratory and the political arena seemed worlds apart. Not so today. Once men achieved a self-sustaining chain reaction, it was inevitable that physical science and political science—or, perhaps more accurately, the art of government—would meet on common ground.

The control of atomic energy represented more than a tremendous scientific achievement—it opened a historical era in which science could either destroy civilization as we know it or else make men rich beyond measure. Today, not only our hopes for material well-being but also our very hopes for national survival are intimately related to the health and vigor of our science and to whether scientific discoveries are used foolishly or wisely. No responsible government official can now be indifferent to the happenings in our scientific laboratories. By the same token, our scientists—rightly concerned with the social consequence of their research—seek to know more about the art of statecraft. Put differently, science and statecraft today find themselves locked in a partnership born of hard necessity. It is up to the public officials and the scientists to make this partnership harmonious and productive.

By positive and affirmative deeds, the men and women of American science have demonstrated their awareness of their responsibilities in the partnership of science and statecraft and their willingness to carry them. I need not recount the names of those distinguished researchers who, despite longing to work in university laboratories on fundamental science, have helped develop the modern armaments we need if we are to stay alive and free. I need not recount the names of those who now work anonymously behind walls of secrecy, and who might have been Nobel prize winners if their research had been freely published and known to the scientific community at large. I need not list those who, by working on classified problems, have denied themselves the international scientific reputations that otherwise would have been theirs.

All of us who sit on the Joint Committee on Atomic Energy are grateful for what American science has contributed to our national well-being and military security. I would not expect any group of scientists unanimously to applaud every action of the United States Congress or the Executive Branch affecting scientific work—anymore than I would expect the American people to exhibit unswerving enthusiasm for all the policies of any administration. I ask only recognition of the tremendous complexity of the problems faced by our lawmakers in drafting legislation that bears on scientific research. All too often, our lawmakers must choose between imperfect alternatives, neither of which is completely satisfactory.

To cite one example—the problem of secrecy and security. It is easy enough, in the abstract, to outline the objectives of a wise security system. All of us would agree that military secrets of real consequence must be zealously guarded. All of us would agree, at the same time, that a democracy does not take happily to restrictions on the free interchange of information. We would agree that science is dependent for its very life blood on the cross-fertilization of ideas. All of us would agree also that men who give their allegiance to a foreign tyranny must be excluded from classified work. All of us would agree, at the same time, that patriotic dissent must never be mistaken for disloyalty.

It is one thing to reach agreement on such statements of principle. It is another thing to translate these principles into a working security system that protects both sacred individual liberties and the national interest and also guards precious military secrets without stifling scientific progress. In the working of such a system, there cannot be any substitute for humane and wise judgment. And wherever judgment is involved, men of reason and patriotism can entertain honest differences of opinion.

Certainly a good security system can never be static, and our regulations must of course be responsive to changing problems. For its own part, the Joint Committee keeps the Atomic Energy Commission security program under constant study and review. Recall that the Atomic Energy Act of 1954 includes major changes related to control of information. From time to time, it no doubt makes sense to take a completely fresh look at security. Yet we shall only delude ourselves if we think that such reexaminations, no matter how earnestly carried out, can result in programs that offer absolute guarantees against possible injustices, coupled with equally absolute guarantees against the compromising of vital information. Security is now, and will continue to be, a hard and vexing problem.

The only true and fundamental solution to the problem of security lies in building a world in which national survival does not depend on continued military supremacy. The prerequisites of such a world are clear: The Soviet rulers would be required to demonstrate, by affirmative deed, that they had irrevocably renounced their designs for world conquest. The surest proof of such change of heart would lie in the will-

* This article is based on an address given at the meeting of the Mohawk Association of Scientists and Engineers, 14 Jan. 1955, in Schenectady, N.Y.

ingness of the Soviet government to put the manufacture of all armaments under effective international control.

Almost a decade ago, our country came before the United Nations with a just and workable plan for regulating the output of atomic weapons. We have been no less willing to submit the manufacture of conventional arms to international control. But to the world's loss—and to the loss of the everyday Russian people as well—the Soviet overlords have refused to enter into programs which could accomplish these ends.

As a result, our nation is now denied the opportunity to employ its resources and skills solely in the pursuits of peace. Instead, we find ourselves forced to build a stockpile of nuclear weapons. We find ourselves forced to build more effective continental defenses against the atomic and hydrogen bombs now in the hands of our declared enemies.

To the great credit of American science, its representatives were in the forefront of those who warned that the Soviets would quickly achieve the atomic bomb. To the credit of American science also, its representatives are now raising storm warnings concerning the ominous progress of Soviet science and technology. Far too many Americans are still underestimating Soviet prowess in both basic and applied science. Far too many of us still believe it is impossible for the Soviets to overtake and surpass America's present scientific lead.

Yet the facts are these: The Soviets have assigned top priority to building up a vast reservoir of scientific manpower. This year, the Soviet educational system will graduate more scientists and engineers than will our own universities. Projections for the next several years indicate that the gap between the number of scientific and technical graduates in each of the two nations will widen—in favor of the Soviets. By 1965—if present trends continue unchanged—American science may be forced to yield world leadership to the Soviets. Since military supremacy is today almost synonymous with scientific supremacy, the balance of world power may thereby shift decisively in favor of the Soviet Union.

What are we going to do about it? I earnestly hope that the 84th Congress will ask itself whether new legislation is necessary to help speed up the tempo, without diluting the quality, of our scientific training. Would it be desirable to increase the number of government-sponsored fellowships in the scientific fields? Might revisions of our tax laws permit industry and philanthropic organizations to give even more support to science? Is it feasible to amend our Selective Service legislation, so that scientific education can be encouraged without compromising the principle of equality of sacrifice? Such questions are of supreme importance to the future of our country, and I am sure that the Congress would seek the advice of the American scientific community in attempting to answer them.

One word of warning, however: Let us never believe that we can maintain our scientific leadership simply by producing great numbers of doctors of philosophy on some educational assembly line. In science, quality overshadows quantity. Our Enrico Fermis may occur only once in a generation, and not even a scientific training program 10 times our present size could offer guarantees of producing another Newton or Faraday.

The problem of creating a better science, in other words, is not simply a governmental problem—it is a problem for all America. It is a problem that begins in our homes, where wise and loving parents can teach their children that intellectual exploration is among life's greatest delights. It is a problem that goes on in our schools and in our universities, where dedicated teachers can persuade their students that a life devoted to science is a rich life—in terms of both individual rewards and service to mankind. It is a problem that continues in our communities, where all of us can help create a climate congenial to those oftentimes lonely researchers whose minds dwell on the frontiers of our intellectual universe.

Today, I fear a few Americans do not understand the nature, and mission, of science. Such Americans lament the day on which the Pandora's box of the atom was opened. They grant that atomic energy, if harnessed for constructive uses can bring man unparalleled riches. At the same time, they question man's ability to use the atom exclusively for such ends. In their hearts, such men long to return to the preatomic age—an age of lesser rewards but also of lesser perils.

Yet surely the world will not find its salvation in vain attempts to turn back the clock on scientific progress. Surely history teaches that we go forward, not by suppressing inventions, or by artificially stifling intellectual inquiry, but by boldly exploring the unknown and then using our discoveries in a manner harmonious with the purposes of our Creator. It will be a sad day if ever we hesitate to cross new frontiers of the intellectual universe for fear of what may lurk in the unknown lands beyond.

Atomic energy, it cannot be repeated too often, is like any other force in nature. Like fire, like the wheel, like high explosives, like the high-combustion engine, the atom is indifferent to man's aspirations. It is not pro-American; it is not pro-Soviet. It is not pro-peace; it is not pro-war. The actions of man—and of man alone—will determine the meaning of atomic energy for world civilization.

Will the split atom split the world asunder and ravage our planet and destroy the works of man? Or will this new force prove to be man's greatest material ally in his timeless struggle against the common enemies to mankind—poverty, hunger and disease? A clear-cut and inescapable choice between unparalleled destruction and unparalleled abundance—this is the choice now confronting the world.

It has been the glory of this generation to penetrate the deepest reaches of the physical universe and to discover a new force of nature of incalculable

power. But history will judge this generation according to how it employs this new force. We Americans do not regard ourselves as the moral custodians of the world, and we may not be responsible for how other nations confront the great challenge of the atom. But we are responsible for our own conduct—for what we do or do not do.

In his magnificent speech before the United Nations in December 1953, President Eisenhower made it clear how the American people proposed to resolve the atomic dilemma. He made it clear that we stand willing to join with the other nations in using atomic energy in a great world-wide crusade against human misery and want. In passing the Atomic Energy Act of 1954, the United States Congress declared its support of the objectives of our President's peacetime international atomic pool plan. Following this, our Government announced its willingness to contribute significant quantities of atomic materials to a peacetime international atomic energy agency, and our British and Canadian allies made similar offers.

Men of small minds can always prove, in advance, that such magnificent undertakings as this peacetime international atomic energy agency will never be consummated. But I say that this nation of ours has not prospered and grown great by heeding the advice of those with no vision.

I refuse to believe that man is now inadequate to the task of using the atom for the betterment of man. I refuse to believe that the road the world is now traveling must end in the destruction of all we hold dear. I believe instead that the atomic age is as full of promise as of peril. I believe instead that man, using the wisdom and the fortitude that God has given him, has it in his power to meet and conquer the great challenge of this era—making the atom the touchstone to a world of abundance and justice for all men everywhere.

News and Notes

Marine Biological Laboratories

From 18 to 23 Apr. 1955 an International Conference on Marine Biological Laboratories sponsored by IUBS was held in Rome at the Consiglio Nazionale delle Ricerce. Seventeen panel members representing marine laboratories in 12 countries and 19 observers representing either laboratories in seven additional countries or international organizations took part in the conference. Official participants were Philip B. Armstrong (U.S.A., unable to attend because of illness), Lawrence R. Blinks (U.S.A.), Hans Brattström (Norway), Adolph Bückmann (Germany), Reinhard Dohrn (Stazione Zoologica di Napoli), Pierre Drach (France), Louis Fage (France), H. A. F. Gohar (Egypt), John L. Hart (Canada), Robert W. Hiatt (U.S.A.), Carl L. Hubbs (U.S.A.), Denzaburo Miyadi (Japan), John Runnström (Sweden), F. S. Russell (Great Britain), Tonko Söljan (Yugoslavia), Gunnar Thorson (Denmark), Charles M. Yonge (Great Britain), and G. Montalenti (Italy).

An organizing committee composed of Runnström, Yonge, and Hiatt prepared the conference program and selected the participants. In making selections the committee was forced to limit the number because of financial considerations and the need to insure efficiency in discussion. Other items considered in the selection of participants were geographic factors, types of laboratories, and the experience of individuals in educational and research programs sponsored by such laboratories. Hiatt presided as general chairman.

The chief aim of the conference was to assess the role of marine biological laboratories in the light of present-day trends and demands in biology and in the ever-expanding general field of oceanography, and to explore possible solutions to the practical problems that these laboratories face. Because marine biological laboratories have been established in many countries and for divers reasons, this conference was designed to bring key persons together to achieve world-wide focus on their objectives and problems. The organizing committee was fully aware that the small group of invited participants could in no great measure reflect universal views of those responsible for all laboratories, but all participants agreed that the results of the conference were far reaching in scope and clarified many problems for those responsible for administrative affairs of these research and educational centers.

There were no prepared papers; instead each panel member reviewed the current status of marine biological laboratories in his country or geographic area and then took his turn in leading a general discussion on a specific major problem. In this manner a comprehensive discussion was had on each subject on the agenda by all participants.

Yonge opened the conference by reviewing the historical development of marine biology with special reference to marine biological laboratories. This excellent presentation was then followed by accounts of laboratories, stressing their locations, ecologic associations, affiliation and support, objectives and scope of activities, and major research and teaching facilities. During subsequent days the following topics were discussed at length. (i) Is the marine biological laboratory a logical unit in the service of present-day demands in the marine sciences? (ii) How can marine laboratories make their greatest contribution to educational needs in marine sciences? (iii) What types

of institutional affiliations are most advantageous in promoting current objectives in marine biology? (iv) Is there a need for new kinds or new locations of marine laboratories, or should we try to consolidate the present marine biological laboratories? (v) What is the proper relationship between marine biological laboratories and fisheries research? (vi) What is the proper relationship between marine biological laboratories and the physical aspects of oceanographic research? (vii) How may marine biologists cooperate in the use of equipment and facilities? (viii) What are the current and future sources of financial support for marine laboratories? (ix) Is our present means of disseminating marine biological information sufficient? (x) In what manner can the international exchange of scientific personnel be augmented? (xi) What are the engineering problems of marine biological laboratories? (xii) Should an international directory of marine laboratories be compiled? (xiii) Would an international organization of directors or senior staff members of marine biological laboratories be worth while?

Space does not permit even a summary account of the proceedings here, but a few points digested from the resolutions adopted are presented because of their widespread significance. (i) The term *marine biological laboratory* is too restricted and does not convey the proper scope of work at the laboratories so described. Therefore, such laboratories are encouraged to delete the word *biological*. (ii) Every effort should be made to prevent any increase in the number of marine periodicals and, if possible, to reduce their number by fusion. It was further recommended that marine laboratories be encouraged to distribute collected reprints. (iii) The importance of small laboratories, often affiliated with universities was recognized, particularly as field stations to implement the teaching and research projects of the staff. These laboratories need not justify their existence by becoming major centers of fundamental research. (iv) The conference brought to light a universal shortage of qualified marine biologists and, therefore, recognized the great importance of university courses in marine sciences, which should be available in all countries. (v) The news of new laboratories, particularly in tropical waters, was welcomed, as was the reconstruction of several laboratories in Europe that were destroyed during World War II. Welcomed also was the close collaboration of Scandinavian countries in planning their marine laboratories. The development of marine laboratories through encouragement by UNESCO in South America was noted, and a few vast regions still devoid of such marine laboratories were specified. (vi) The necessity for an international directory of laboratories was made very apparent during the conference, as was the need for information on technical developments in marine science. (vii) The desirability of an international organization of directors and senior staff members of marine laboratories was recognized, and an interim committee was chosen to investigate this and other matters brought forth during the meeting.

The proceedings of the conference will be edited and published for general distribution through IUBS as soon as possible. Copies of the proceedings may be obtained, when published, from G. Montalenti, secretary of IUBS, Instituto di Genetica, Universita, Via Mezzoeannone, 8, Naples, Italy.

ROBERT W. HIATT
University of Hawaii, Honolulu

A New Design for *Science*

Beginning with the 1 July issue, the trim size of *Science* will be increased from 7½ by 10¼ in. to 8¼ by 11¼ in., and the text will be arranged in three columns instead of two. In addition, *Science* has been completely redesigned to make it more modern in appearance and easier and more pleasant to read. The content and organization will remain essentially the same as they are now.

It is felt that the role of *Science* in the dissemination of scientific information can be fulfilled more adequately by the new physical make-up. A more detailed description of the changes and the reasons for making them will be presented in the next issue, in the new format and type face. Revised suggestions to contributors concerning types of articles and the preparation of manuscripts will appear in other July issues.

Science News

On 6 June the U.S. Supreme Court announced its 7-to-2 decision that the Government had wrongfully dismissed **John P. Peters**, professor of medicine at Yale University, from his position as a part-time consultant to the U.S. Public Health Service. The dismissal was the result of the Loyalty Review Board's 1953 "post-audit" finding that there was a "reasonable doubt" as to Peters' loyalty. Before this adverse decision was rendered, Peters had twice been cleared by loyalty boards of the Federal Security Agency, of which the PHS was a unit.

The Court ruled that the action of the Loyalty Review Board was "patently in violation" of the Executive Order that established the board's jurisdiction. The Court's decision ordered the Civil Service Commission

> . . . to expunge from it records the Loyalty Review Board's finding . . . and to expunge . . . any ruling that petitioner is barred from Federal employment by reason of that finding. His prayer for reinstatement, however, cannot be granted, since it appears that the term of petitioners' appointment would have expired on December 31, 1953, wholly apart from his removal on loyalty grounds."

Since the decision was made entirely on technical grounds, it has left the Constitutional issue untouched. Both Peters and the Department of Justice had asked

for the settlement of the question of whether or not a Government worker charged with disloyalty has a right to face his accusers. However, the majority opinion held, in keeping with the tradition of the Court, that

> . . . the case can be decided without reaching the Constitutional issue.
>
> From a very early date, this court has declined to anticipate a question of constitutional law in advance of the necessity of deciding it.

In his concurrence, Associate Justice William O. Douglas could not agree with the majority view:

> With all deference, I do not think we can avoid the Constitutional issue in this case. . . .
>
> Dr. Peters was condemned by faceless informers, some of whom were not known even to the board that condemned him. . . . So far as we or the board know, they may be psycopaths or venal people, like Titus Oates, who revel in being informers. They may bear old grudges. Under cross-examination their stories might disappear like bubbles. . . .
>
> Confrontation and cross-examination under oath are essential if the American ideal of due process is to remain a vital force in our public life.

In a recent issue of *Human Biology* [27, 12 (Feb. 1955)], José Pons reports the results of a study of the **"Sexual diagnosis of isolated bones of the human skeleton."** Linear measurements of the femur and sternum were taken on Portuguese skeletons of known sex. Using Fisher's method, Pons obtained discriminant functions that permitted the sexing of femora with probabilities of accuracy approaching 95 percent. Similarly, using Penrose's method of discriminant functions, he found probabilities of accuracy in sexing sterna to be 89 percent.—W. L. S., Jr.

In a report released on 12 June by Oveta Culp Hobby, Secretary of Health, Education, and Welfare, the Ad Hoc Interdepartmental Committee on Community Air Pollution urged a broad Federal program of research and technical assistance in **air pollution problems.** The committee recommended legislation authorizing such a program, and suggested that the program be administered by the Department of Health, Education and Welfare, with the assistance of a permanent interdepartmental committee on community air pollution. It said that "safeguarding public health is the most compelling reason for extending Federal assistance on air pollution."

The committee, which was appointed by Secretary Hobby last fall at the request of President Eisenhower, was composed of representatives of the departments of Defense, Agriculture, Commerce, and Interior, the Atomic Energy Commission, and the National Science Foundation, in addition to the Department of Health, Education, and Welfare. Leonard A. Scheele, Surgeon General of the Public Health Service, was chairman of the committee.

The committee report reaffirmed the principle of state and local responsibility for community air pollution control. It recommended that the Federal Government aid state and local agencies by conducting and supporting research in this field; collecting and disseminating information; providing technical assistance; and demonstrating new principles and methods. It also called attention to the need for "adequate and exemplary practices for the control of community air pollutants from factories, plants, and other industrial sites operated or controlled by the Federal Government."

In noting the gaps in current knowledge about the nature and effects of air pollution, the committee said that "both the specific chemicals themselves and the concentrations which result in annoyance, discomfort, physical irritation, disabling illness, permanent injury, or even death, have yet to be determined." The report also considered the economic effects of air pollution and called attention to its "adverse effects on plants and animals upon which this country depends for food, fiber, and other essential commodities."

Secretary of the Interior Douglas McKay has announced a **reorganization of the Alaska activities** of the Fish and Wildlife Service. Under this reorganization, Alaska activities will be divided into two major fields: management of the commercial fisheries, and administration of the wildlife and game-fish resources. Donald L. McKernan, assistant director of the service's Pacific Oceanic Fishery Investigations in Honolulu, Hawaii, for the past 3 years, has been named administrator of Alaska commercial fisheries. Clarence J. Rhode, at present regional director of the Fish and Wildlife Service in Alaska, will hold an equivalent title as head of the wildlife management unit.

Research on the Alaska commercial fisheries, which at present is being handled by the Seattle laboratory under the direct supervision of the Washington office, will be included in the commercial fisheries organization so that all functions concerned with the management of the commercial fisheries of the Territory will be directed by a single field organization. Both the commercial fisheries and the wildlife units will have their own enforcement staffs, but personnel, equipment, and facilities will be shifted between the two organizations as seasonal and program demands require. One central unit in the Juneau headquarters office will provide fiscal, personnel, and other administrative services to both organizations.

Scientists in the News

Mary Elizabeth Reid, biologist at the National Institutes of Health, Bethesda, Md., has retired after a long career in public service. She is recognized as an outstanding authority in guinea pig nutrition and vitamin C metabolism and is the author of numerous publications in these fields.

Reid studied at the University of Wisconsin, where she received her Ph.D. degree in plant nutrition in 1923. Her postdoctoral work was carried out at Yale University under Lafayette B. Mendel, and at the Boyce Thompson Institute, Yonkers, N.Y.

James Francis Didusch, internationally known medical and embryological illustrator, died in Baltimore on 16 Mar. at the age of 65. Didusch had been a member of the Baltimore laboratory of the department of embryology of the Carnegie Institution of Washington since 1913, and had contributed hundreds of remarkably accurate drawings to the *Carnegie Contributions to Embryology*. He was well known for his illustrations elsewhere, particularly in clinical books and articles.

Moyer D. Thomas of Stanford Research Institute is the first recipient of the **Frank A. Chambers** award, which was presented on 25 May by the Air Pollution Control Association during its recent annual meeting in Detroit. Named for the late head of the smoke inspection and abatement department of Chicago and pioneer in air research, the award was made to Thomas principally for his development of the Thomas Autometer, a recording instrument for the analysis and measurement of the sulfur dioxide content of the air.

At his own request, after 25 years of service as chairman of the department of plant pathology at the University of Wisconsin, **G. W. Keitt** has been relieved of administrative duties so that he can devote full time to teaching and research. **Glenn S. Pound** has succeeded as chairman.

Fred Allison, who retired recently as head of the physics department and dean of the graduate school at Alabama Polytechnic Institute, has been appointed visiting professor of physics by the University of Texas. His 1-year assignment will be spent at Chulalongkorn University, Bangkok, Thailand.

W. Feitknecht of the University of Bern, Switzerland, was guest of honor at the 29th annual colloid symposium, sponsored by the American Chemical Society's division of colloid chemistry and the Southeastern Texas section of the society, in Houston, Tex., 20–22 June. He presented a paper on the "Size and shape of particles in inorganic colloids."

Charles B. Huggins, professor of surgery and director of the Ben May Clinic for cancer research at the University of Chicago, has received the Benjamin Stockwell Barringer gold medal and award of the American Association of Genito-Urinary Surgeons. He was honored for his contributions to the treatment of cancer.

A pioneer in the study of the relationships between hormones and cancer, he developed surgical approaches for removal of the organs that produce male sex hormones to curb prostate cancer. He also developed surgical techniques for removal of the adrenal glands which have been used in the treatment of advanced cases of breast cancer.

The George Washington University School of Medicine, Washington, D.C., has announced that **Harold Stevens,** associate professor of neurology at Georgetown University, will succeed **Walter Freeman,** professor of neurology, who resigned this semester to move to the West Coast. Stevens is also chief of neurology at Childrens' Hospital, neurologist to the Group Health Association Clinic, consultant in neurology at Crippled Childrens' Hospital and St. Elizabeths Hospital, electroencephalographer with the District of Columbia Health Department, and consultant in neurology at Mt. Alto Veterans Administration Hospital.

Byran Patterson, curator of fossil mammals at the Chicago Natural History Museum and lecturer in geology at the University of Chicago, has been appointed Alexander Agassiz professor of vertebrate paleontology at Harvard University. Patterson has studied the ancestry of mammals, particularly the evolution of mammals in South America.

Roy Bird Cook, practicing pharmacist of Charleston, W.Va., and in addition a historian and author, will be the 1955 recipient of the Remington Honor medal, pharmacy's highest recognition of service to the profession.

Two Carleton College scientists will retire this year: **Harvey E. Stork,** professor of botany, and **Roy A. Waggener,** professor of zoology. Stork has been in the botany department since 1920 and chairman of the department since 1926. In addition, he has directed the college's arboretum since its founding in 1920. Especially interested in the Minnesota Academy of Science, he was the first president of that organization; he is also a past president of the National Association of Biology Teachers. Stork is a graduate of Indiana State Teacher's College, and earned his M.A. degree at Indiana University and his Ph.D. degree at Cornell University. He was in the photography section of the Army Air Service in World War I and is an accomplished nature photographer. His numerous botanical expeditions include four to Costa Rica and one to the Andes, where he was second in command of the University of California Botanical Garden Expedition. He has written two textbooks, *Studies in Plant Life* and *Evolution of Plants*.

Waggener has been a member of the Carleton faculty for 27 years and was chairman of the department of zoology for 15 years. He is a graduate of La Grange College, took his M.A. degree at Brown University, and earned his Ph.D. degree at Cornell University in 1927. Before joining the Carleton staff, he taught at Brown and did summer teaching at the Marine Biological Laboratory, Cold Spring Harbor, N.Y. He has also been a high-school teacher and was a superintendent of schools in Missouri. Waggener has conducted extensive research in mammalian and amphibian histology, physiology and endocrinology.

The Georgetown University School of Dentistry Award of Merit for 1955 has been given to **George C. Paffenbarger,** senior research associate of the American Dental Association at the National Bureau of Standards. He was honored for "significant contribution to dental research in the field of dental materials during the past 25 years."

Robert H. Alway, head of the pediatrics department at the University of Colorado since 1953, has been appointed professor of pediatrics and executive head of the department in the Stanford University School of Medicine.

Another appointment at Stanford is that of **Quentin Monroe Geiman**, now teaching in the Harvard School of Public Health, who will become professor of preventive medicine, specializing in tropical public health.

Carroll M. Williams of Harvard University gave the Purdue Biological Society special lectures for 1955. He discussed "Insect metamorphosis: a tool for the study of growth."

Ross A. Baker, special lecturer in chemistry at San Diego State College, was the recipient recently of the Oscar R. Foster award of the Chemistry Teachers' Club of New York. This honor has been bestowed annually for the past 19 years upon a member of the teaching profession for meritorious service to students and to the club.

Frederick S. Philips, head of the department of pharmacology, Division of Experimental Chemotherapy of the Sloan-Kettering Institute for Cancer Research, New York, has been appointed research consultant for the American Cancer Society, effective 6 Sept.

In his new post, Philips will be concerned with research directed toward finding practical chemotherapeutic agents effective against cancer in man. The research will not be limited to a search for chemical agents; attention will also be given to materials of natural origin, such as viruses and hormones.

The following appointments to assistant professor have been announced by Massachusetts Institute of Technology: **Frank J. Heger, Jr.**, structural design, department of civil and sanitary engineering; **Louis N. Howard**, mathematics; **Herbert M. Jenkins**, economics; **Edward N. Lorenz**, meteorology; **Charles L. Miller**, surveying; **Charles C. Reynolds**, metallurgy.

Meetings

The fifth summer seminar of the **Canadian Mathematical Congress**, which will be on analysis, will be held at the University of Manitoba, Winnipeg, 17 Aug.–9 Sept. Lectures will be presented by Heinrich Behnke, W. K. Hayman, and Jean Leray. A subseminar will be conducted by V. Hlavatý, and instructional courses will be given by G. D. E. Duff, N. S. Mendelsohn, and D. B. Sumner. For information address the Secretariat, Canadian Mathematical Congress, Chemistry Building, McGill University, Montreal, Canada.

Participants in the University of Michigan's sixth annual summer-session biological symposium, **Human Biology: Integrating Mechanisms in Man**, to be held at Ann Arbor, 11–22 July, are as follows:

Frank A. Beach, Sterling professor of psychology, Yale University. Contributions: effects of hormones on behavior of animals; nervous mechanisms in reproductive behavior; *Patterns of sexual behavior.*

Karl H. Pribram, director of the department of neurophysiology, Institute of Living, Hartford, Conn. Contributions: neuronographic analyses of cerebral cortex; neural mechanisms in rage and placidity; cortical action and organization.

James G. Miller, chairman of the department of psychology, University of Chicago. Contributions: analysis of unconscious processes; personality assessment; psychotherapy.

A. Irving Hallowell, professor of anthropology, University of Pennsylvania. Contributions: general ethnology; personality and culture; test procedures for culture studies; general psychobiological characteristics of man; *Culture and experience.*

The 83rd annual meeting of the **American Public Health Association** and 40 related organizations will take place in the Kansas City, Mo., Municipal Auditorium, 14–18 Nov. More than 5000 public health workers representing city, county, state, national, and international organizations are expected to attend. The topic of an opening general assembly, "Where are we going in public health?," will also be the theme of the entire meeting. Designed to lend perspective to the 5-day conference, this initial assembly will deal with changing factors such as population redistribution, increased mobility of people, and increase in the aged population, all of which affect public health needs. Outstanding authorities from outside the health field are being invited to participate. In all, 400 scientific papers will be presented during 75 sessions. For information, write to the association at 1790 Broadway, New York 19.

Education

Last month **Kalamazoo College** held ground-breaking ceremonies for the Louis C. Upton Science Hall, which is to house the biology department. The new building, together with the R. E. Olds Science Hall, will give the college complete facilities in three basic fields of science—biology, chemistry, and physics. During the ceremony tribute was paid to Frances Diebold, head of the department of biology, who is credited with having raised the department to its present stature.

A collection of more than 700 volumes and other **literature on archeology** has been presented to the department of anthropology and sociology of the University of California, Los Angeles, and to the Southwest Museum by Kenneth Macgowan, professor of theater arts at U.C.L.A. and vice president of the Southwest Museum. The collection contains much archeological literature about Mexico and Central America and includes many works on Mayan civilization.

The books, many of which are out of print, are

from Macgowan's private collection, considered to be one of the most complete and best balanced libraries of its kind in the nation. In addition to his activities in motion pictures and the theater, Macgowan for many years has had an active interest in archeology, and has been widely recognized for his contributions to the field.

Carnegie Technical, campus publication of the Carnegie Institute of Technology, has devoted its entire April issue to the problems of preparation for **careers in engineering and science.** Prospective students, guidance counselors, and science teachers should find the articles contained in the issue very helpful. A limited number of copies has been reserved for interested persons.

Purdue University's new $4-million chemistry building was dedicated on 16 June, the final day of the American Chemical Society's 14th national organic chemistry symposium, which was sponsored jointly by the university, the society, and the society's Purdue section. Twelve organic chemists participated in the symposium: Roger Adams of the University of Illinois; John D. Roberts of California Institute of Technology; Arthur C. Cope of Massachusetts Institute of Technology; Nelson J. Leonard of the University of Illinois; Gilbert Stork of Harvard University; Stanley J. Cristol of the University of Colorado; Frank H. Westheimer of the University of Chicago; Melvin Calvin of the University of California; George S. Hammond of Iowa State College; John C. Bailar, Jr., of the University of Illinois; Elias J. Corey, also of Illinois; and Vincent du Vigneaud of Cornell University.

In the Laboratories

Headquarters of the **Air Force Cambridge Research Center** moved on 10 June to new quarters at Laurence G. Hanscom Field, Bedford, Mass. Only a few military and civilian personnel will remain at the original Cambridge address. These persons, employed in one of the scientific laboratories and in the comptroller and procurement divisions, will move to Bedford at a later date when additional construction is completed.

On 17 May production lines started rolling in the **Fisher Scientific Co.'s** new reagent-chemical plant, which has been built on a 9-acre site in Fair Lawn, N.J. This is thought to be the first plant in this country designed exclusively for reagent chemicals. The new $1.2 million facility will produce chemicals in lots of only a few hundred pounds; each lot will receive as many as 14 laboratory tests.

The **Dalmo Victor Co.**, San Carlos, Calif., a subsidiary of Textron American, Inc., has announced plans for a new $1.2 million building to bring under one roof all of the electronic firm's present facilities. The 180,000 ft², L-shaped plant will be constructed on 10 acres of land in Belmont, Calif.

Sales of **liquid insecticide sprays** in the United States totaled 10.4 million gallons last year, an increase of 21 percent over 1953, according to a report read at the 41st mid-year meeting of the Chemical Specialties Manufacturers Association. The estimate was based upon returns from 70 firms representing the major portion of the insecticide industry.

Miscellaneous

The first results of an intensive research program by the Air Force into the effects of hydrogen contamination in **titanium and titanium alloys** have just been made available to industry by the Office of Technical Services, U.S. Department of Commerce, in a report prepared by Wright Air Development Center. The report consists of papers and discussions presented at a WADC technical meeting in late 1954. Entitled *Hydrogen Contamination in Titanium and Titanium Alloys: Part 1, Hydrogen Embrittlement in Alpha-Beta Titanium Alloys*, the publication may be obtained for $4.75 from OTS, U.S. Department of Commerce, Washington 25, D.C. (Order PB 111620).

The official reports of the seven **medical research** institutes of the U.S. Public Health Service outlining their accomplishments in 1954 in developing better methods for preventing, diagnosing, and treating such diseases as mental illness, cancer, heart disease, and arthritis, are included in a 56-page publication entitled *Medical Research Accomplishments*. In these authoritative reports, each institute points to progress achieved in 1954 by institute investigators or by investigators at non-Federal laboratories who have been aided by Federal grants.

About two-thirds of the approximately $80 million appropriated annually for the National Institutes of Health supports research and training in universities, medical schools, and other nonprofit voluntary organizations. The pamphlet is available from the Social Legislation Information Service, 1346 Connecticut Ave. NW, Washington 6, D.C., at $1 per copy.

The New York Zoological Society is exhibiting a reptile rarity, a pair of **Komodo Monitors,** in the Bronx Zoo's Reptile House. These largest of living lizards are the only ones on exhibition outside their native Indonesia.

A new edition of a directory of services and facilities available to cancer patients throughout the United States has been issued by the Public Health Service, U.S. Department of Health, Education, and Welfare. The directory, ***Cancer Services and Facilities in the United States, 1954***, compiled by the National Cancer Institute, may be purchased from the Superintendent of Documents, Government Printing Office, Washington 25, D.C., for 45 ct a copy.

The revised volume lists for the first time institutions and laboratories offering tissue diagnostic and cytodiagnostic services, as well as homemaker services available to cancer patients.

Technical Papers

Demonstration of Tyrosinase in Melanocytes of the Human Hair Matrix by Autoradiography

Atsushi Kukita and Thomas B. Fitzpatrick

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The histochemical method of tyrosinase determination is based on the detection of melanin newly formed from tyrosine (*1*) and is not applicable to pigment cells that are already fully melanized. In order to extend this technique to the determination of tyrosinase activity in pigmented melanocytes (pigmented skin and hair, nevi, and melanomas), we have developed an autoradiographic-histochemical method that utilizes C^{14}-labeled tyrosine as the substrate.

The conversion of water-soluble tyrosine to insoluble melanin on the surface of the melanin granule presents a unique opportunity for the utilization of an *in vitro* autoradiographic technique. When the tissue is incubated in radioactive tyrosine, the melanocytes that contain an active tyrosinase convert the labeled tyrosine to labeled melanin which is fixed to the melanin granule. The unreacted, water-soluble radioactive tyrosine is washed out of the tissue, and it is then possible to record *only* the newly formed radioactive melanin on the photographic emulsion.

The autoradiographic tyrosinase method is being utilized in an extended study of the concentration and activity of tyrosinase occurring in human pigmented nevi and malignant melanomas (*2*). In this paper we present the application of this method to the demonstration of tyrosinase in melanocytes in the matrix of the human black hair bulb (*3*). In addition, it is shown that the albino and gray hair matrices do not contain tyrosinase.

Excision biopsies of human scalp skin were taken under local anesthesia from four volunteers with black hair, four with gray hair, and one albino. Tissue slices, 1 to 2 mm thick, were immersed in 2.2 ml of 0.1*M* phosphate buffer at *p*H 6.8 which contained 0.3 μc of DL-tyrosine-2-C^{14} (*4*) (0.5 μc/mM) and 3000 units of crystalline penicillin G. Incubation was carried on for 24 hr at 37°C in a Dubnoff shaker. As a control, slices from the same specimen were treated identically, except that, in addition to the substrate, a tyrosinase inhibitor, sodium diethyldithiocarbamate (0.01*M*), was present. The inhibited specimen was necessary to detect traces of unreacted radioactive tyrosine that might not have been removed from the tissue slices by washing. Following incubation, the tissue slices were fixed in 10-percent formalin for 1 hr and washed in running water for 8 hr. To prepare the tissue for autoradiography (*5*), the specimens were dehydrated, cleared in toluene, imbedded in paraffin, sectioned at 4 μ, and mounted directly on Eastman Kodak 1- by 3-in. NTB_3 (25 μ) nuclear track plates. After they were air-dried, the sections were thoroughly deparaffinized by immersion in two changes of xylol for 10 min each.

The autographic slides on which the sections were mounted were stored in black, light-tight slide boxes, sealed with photographic masking tape, and exposed for 2 wk. Following exposure, the slides were developed in Eastman D-19 developer, fixed in 20-percent sodium hyposulfite, washed, and dried in air. The tissue was then stained with lithium carmine (*5*).

Melanocytes in the hair matrix of a black hair bulb are illustrated in Fig. 1A, and the tyrosinase activity of the melanocytes is shown in Fig. 1B. The tyrosinase in the melanocytes has catalyzed the oxidation of C^{14}-labeled tyrosine to C^{14}-labeled melanin. The radioactive melanin has produced a latent image in the silver bromide crystals of the photographic emulsion. The photographic developer then reduces the grains with latent images to metallic silver. These metallic silver grains are seen outlining the hair matrix in Fig. 1B. The same melanocytes that contained tyrosinase did not catalyze the conversion of the labeled tyrosine to labeled melanin in the presence of sodium diethyldithiocarbamate (Fig. 1C). Gross examination of the hair bulbs after incubation revealed a darkening of the black hair bulb incubated in labeled tyrosine but no change in color in the hair bulbs incubated in labeled tyrosine and sodium diethyldithiocarbamate.

Examination of the epidermal-dermal junction of

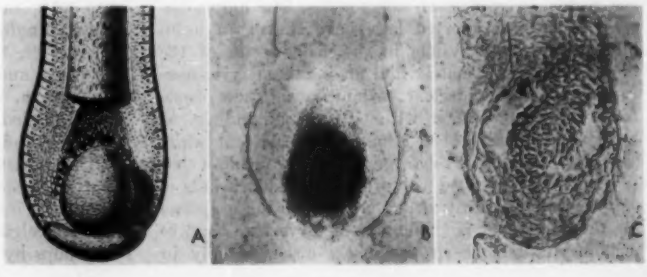

Fig. 1. Melanocytes occupy the upper portion of the bulb of a black human hair (*A*) and are arranged as an inner cone surrounding the upper part of the dermal papilla. Heavy deposition of silver grains (*B*) indicate the site of radioactive melanin formation from C^{14}-labeled tyrosine by melanocytes. Presence of sodium diethyldithiocarbamate blocks melanin formation (*C*). (×80)

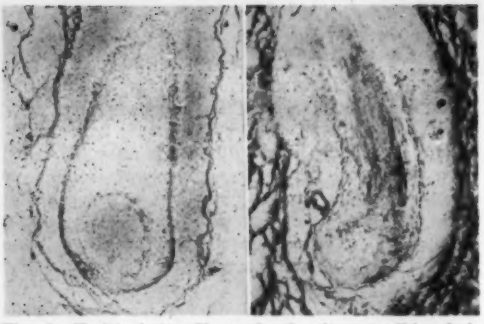

Fig. 2. (Left) Autoradiograph of a human albino hair bulb that has been incubated in C^{14}-labeled tyrosine. No evidence of radioactive melanin formation is seen in the area of the matrix. (×89) Fig. 2. (Right) Autoradiograph of the hair bulb of a 56-year old male with gray hair. No tyrosinase activity is noted in the area of the matrix. (×155)

the same autoradiograph of human white scalp skin containing tyrosinase-active melanocytes in the black hair bulb revealed that the *epidermal* melanocytes did not convert labeled tyrosine to labeled melanin.

Melanocytes located in the albino hair bulb failed to convert labeled tyrosine to labeled melanin, as is evidenced by the absence of silver grains in the area of the matrix (Fig. 2, left). Thus, albino melanocytes in the hair matrix lack the enzyme tyrosinase necessary for melanin synthesis. In a previous study (*6*), melanocytes were identified in human albino epidermis with gold impregnation. The absence of melanin in albino epidermal and hair matrix melanocytes is, therefore, the result of a genetically transmitted tyrosinase deficiency and cannot be attributed to lack of melanocytes.

Figure 2 (right) is a tyrosine-C^{14} autoradiograph of the hair matrix of a gray hair bulb. The absence of silver grains in the area of the matrix indicates a lack of tyrosinase in the human gray hair matrix.

The autoradiographic tyrosinase method has revealed that an important difference exists between the state of the tyrosinase system located within melanocytes of the human epidermis and the melanocytes of the human hair matrix. Previous histochemical studies (*1*) with irradiated and unirradiated human white skin established the existence of an *inhibited* tyrosinase system in epidermal melanocytes. The autoradiographic studies reported here have shown an uninhibited tyrosinase system in the melanocytes of the human black hair matrix and an inhibited tyrosinase system in the epidermal melanocytes. These basic facts are in agreement with the clinical findings of heavily melanized (black) hair and coexistent white skin. It appears that the large amount of melanin that is required to pigment rapidly growing black hair is supplied by the active-functioning tyrosinase system in the hair matrix melanocytes. Tyrosinase-active melanocytes have been previously observed only in irradiated skin and in malignant melanomas (*7*). To repeat, the tyrosinase system in *epidermal* melanocytes remains in a relatively dormant state unless it is activated by ionizing radiation.

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Effect of Feeding Dogs the Flesh of Lethally Irradiated Cows and Sheep

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To our knowledge, there have been no reports of studies concerning the possible toxicity of the ingested flesh of animals receiving lethal doses of gamma radiation. Based on biophysical conceptions of the interaction of radiation and matter, it was the consensus that the flesh of these animals would not prove harmful if it were consumed (*1*). The present experiments were designed to test these opinions (*2*).

Lewis *et al.* (*3*) and Witt *et al.* (*4*) have shown that sterilization by high levels of irradiation does not impart toxic properties to foods. This would indicate that, if deleterious compounds occurred in the flesh of irradiated animals, they would be the result of the effects of ionizing radiation on living systems. Several workers (*5*) have implicated toxic humoral factors as a constituent of the total-body irradiation syndrome. Thus, the possibility existed that the ingestion of flesh from irradiated animals might prove injurious.

Cobalt-60 sources of gamma radiation, arranged at a site described by Wilding *et al.* (*6*), were used for the exposures. The rate of irradiation was approximately 40 r/hr. One cow received 6400 r and another 7000 r of continuous total-body radiation, and they were destroyed *in extremis*. Sheep died from exposures of 90 hr (3600 r) to 132 hr (5280 r). An initial hyperirritability followed by complete physical collapse were the only gross symptoms noted in the irradiated animals. The cattle had a slight increase in erythrocytes, together with the near annihilation of leukocytes and a 70-percent reduction in platelets *ante mortem*. The flesh of the boned carcasses of the two irradiated and two control cows and the nine irradiated and nine control sheep was ground twice and maintained in a frozen state until used.

Fifteen weanling pure-bred male beagle pups were used in the irradiated cow study. In trials I and II, seven and eight pups, respectively, were divided into two groups by weight and litter (Table 1). The basal

Table 1. Effect of ingestion of flesh from irradiated animals on the growth of dogs.

Trial	Breed	Source of flesh	Number of animals	Length of experiment (days)	Average initial weight (kg)	Average final weight (kg)	Average daily gain* (g)
I	Greyhound	Irradiated sheep	4	128	2.7	20.0	135 ± 3
I	Greyhound	Control sheep	3	128	3.0	20.1	134 ± 2
I	Beagle	Irradiated cattle	4	129	1.4	7.4	47 ± 7
I	Beagle	Control cattle	3	129	1.4	6.8	42 ± 3
II	Beagle	Irradiated cattle	4	129	2.1	8.6	50 ± 3
II	Beagle	Control cattle	4	129	2.3	8.3	46 ± 5

* Mean ± standard error of the mean.

diet, in percentages, consisted of ground beef (fresh weight), 56.6; sucrose, 29.5; cornstarch, 4.7; hydrogenated vegetable fat, 2.9; salts (USP XIV), 3.9; and nonnutritive fiber, 2.4. The vitamin supplement contributed the following in milligrams per 100 gm of ration: thiamine, 0.36; riboflavin, 0.36; pyridoxine, 0.36; folic acid, 0.36; calcium pantothenate, 10.8; *p*-aminobenzoic acid, 10.8; nicotinamide, 7.2; inositol, 90.0; choline chloride, 180.0; and biotin 0.018. Vitamins A, D, and E, at levels of 5600 IU, 700 IU, and 700 IU, respectively, were administered twice weekly to each dog. The groups received the ground beef from either the irradiated animals or the nonirradiated control. The pups were fed at a level estimated to provide an adequate caloric intake for maintenance and growth (*7*).

In the experiment in which irradiated sheep were used, seven weanling pure-bred male greyhound pups were divided into two similar groups by weight. The experimental diets consisted of ground meat from either irradiated or nonirradiated sheep mixed with an equal weight of granular commercial dog ration. The mixed ration, stored under refrigeration, was fed to all pups in amounts that varied from 50 gm per dog each day, initially to 400 gm per dog each day at the end of the experiment. A pelleted commercial dog ration was constantly available for *ad libitum* intake.

All the dogs were fed their respective diets for the length of time indicated in Table 1. Periodic weight measurements were made during this time. Immediately before the termination of the experiment, blood samples from all animals were obtained for hematological and blood chemical determinations. Dogs from each group were sacrificed for gross and histopathological examination. At autopsy, the weights of various organs were obtained.

Total and average daily gains of the beagles and greyhounds are shown in Table 1. The growth curves of the six groups are shown in Fig. 1. No difference in weight gain attributable to the ingestion of ground meat from either the irradiated beef or sheep was apparent. Subtle nutritional differences in the diets could not be assessed under the conditions of this experiment.

Hematological examination of the blood samples from all groups revealed no statistically significant differences in leucocytes, hemoglobin, erythrocytes, or platelets. No differences were noted in the following blood values: thymol turbidity, bilirubin, serum protein, serum albumin, cholesterol, inorganic phosphorus, glucose, creatinine, uric acid, and nonprotein nitrogen.

At autopsy, no pathological changes were observed in the organs of any beagle or greyhound that received ground meat from the irradiated beef or sheep. Preliminary histopathological examination also showed no adverse effects attributable to treatment. Comparisons of the weights of lungs, heart, spleen, liver, kidney, brain, thyroids, and adrenals indicated no statistical difference between any given treatment and its corresponding control.

Under the conditions of this short-term experiment, the data indicate that the flesh from lethally irradi-

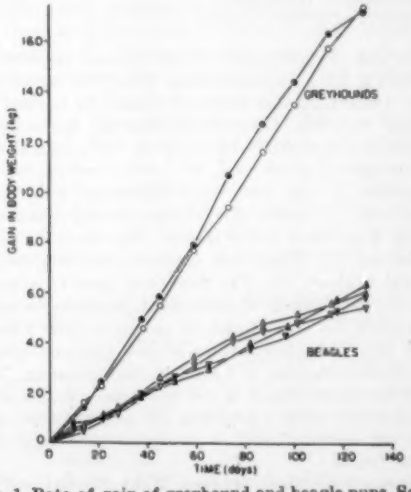

Fig. 1. Rate of gain of greyhound and beagle pups. Source of ingested flesh: ○ irradiated sheep; ● control sheep; △ irradiated cattle, trial I; ▽ control cattle, trial I; ▲ irradiated cattle, trial II; ▼ control cattle, trial II.

ated cows or sheep is not grossly injurious or toxic to the canine when it is ingested. These results were confirmed in other species, that is, in albino rats and chicks when they were fed the flesh or selected organs from irradiated animals (*8*).

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Inheritance of High Total Carotenoid Pigments in Tomato Fruits

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The red-colored variety Webb Special has been observed to have approximately twice the amount of total fruit pigments that are found in normal red tomato varieties. Genetic variation in the color of tomato fruits depends basically on the interaction of two nonallelic genes: red, $r^+ - t^+ -$; yellow, $rrt^+ -$; tangerine, $r^+ - tt$; and light tangerine, $rrtt$. Table 1 indicates the extent of variation in total carotenoids in the four basic color classes. For analytic procedures, see (*1*). These data confirm those reported by several workers (*2*). The dominant gene r^+ is necessary for production of carotenoid pigments in quantity, while the gene t^+ and its recessive allele t determine the qualitative nature of the pigment system. The dominant gene t^+ produces the lycopene, beta-carotene system found in red and yellow fruits, while the recessive allele t produces the zeta-carotene, prolycopene system found in tangerine and light tangerine fruits.

Crosses were made between Webb Special and the pale-yellow variety Snowball and the tangerine variety Orange King. Table 2 presents the F_2 segregation for the two crosses. The high-pigment segregates are relatively easy to classify, since the increased fruit pigmentation appears to be positively associated with a dark-green plant and fruit color.

The high-pigment character segregated as if it were conditioned by a single recessive gene in the Webb Special × Snowball cross. The 15 : 1 ratio obtained in the Webb Special × Orange King cross indicates that two nonallelic recessive genes are necessary for high-fruit pigmentation. Progenies of all the high-pigment F_2 segregates were classified and observed to breed true for high-fruit pigmentation in the F_3 generation.

The two recessive high-pigment genes from Webb Special have been designated tentatively as hp_1 and hp_2. The recessive high-pigment gene isolated from Snowball has been designated as hp_1. Progress is being made in the isolation of the hp_2 gene. Data in Table 2 indicate that the two nonallelic genes for high pigmentation are inherited independently of the r^+ and t^+ genes. The hp_1 and hp_2 genes also appear to be independent of the y^+ gene that conditions fruit skin color.

It is of interest to note that Snowball, which has the lowest total pigments of any variety tested, has one of the two recessive genes necessary for high-fruit pigmentation. An interaction of the two recessive genes (hp_1 and hp_2) is necessary to obtain the quantitative increase in carotenoid pigment production. The individual functions of the two nonallelic genes have not been determined. The two genes appear to have little or no qualitative effect on the two pigment systems conditioned by the r^+ and t^+ genes. Pigment production in the yellow (rrt^+t^+) genotype is markedly reduced, even in the presence of the two high-pigment genes. The quantity of pigment produced appears to be slightly increased over that of the normal yellow varieties.

The practical implications of increased pigmentation in tomato fruits are important. This is especially true of the red-fruited varieties. The consumer demands a deep-red color in processed tomato products as well as in the fresh fruit. The lycopene and the beta-carotene contents are both increased by the high-pigment genes, which thus increase the nutritive value of the tomato fruit as well as the visual appearance.

Table 1. Variation in total carotenoid pigment content of tomato varieties (mg/100 g fresh weight).

Variety	Flesh color	Genotype	Total carotenoids
Rutgers	Red	$r^+r^+t^+t^+$	6.76
Stokesdale	Red	$r^+r^+t^+t^+$	7.12
Webb Special	Red	$r^+r^+t^+t^+$	12.96
Orange King	Tangerine	r^+r^+tt	7.36
Golden Jubilee	Tangerine	r^+r^+tt	7.00
Snowball	Yellow	rrt^+t^+	0.12
Golden Queen	Yellow	rrt^+t^+	0.24
U of I Acc. 36	Light tangerine	$rrtt$	1.08
U of I 1007-129-54	Light tangerine	$rrtt$	0.70

Table 2. F_2 segregation for fruit color and high pigmentation.

	Normal pigment			High pigment			Total
	Red	Yellow	Tangerine	Red	Yellow	Tangerine	
Webb Special × *Snowball*							
Observed	174	57		48	17		296
Expected	9	3		3	1		
$\chi^2 = 1.514$, 3 degrees of freedom, $P = 0.50–0.70$							
Webb Special × *Orange King*							
Observed	69		25	7		1	102
Expected	45		15	3		1	
$\chi^2 = 1.404$, 3 degrees of freedom, $P = 0.70–0.80$							

In addition, the fruits of the high-pigment selections exhibit a high degree of firmness. Whether this is because of a close association of independent genetic factors or because of a pleiotropic effect of one or both of the high-pigment genes has not yet been determined.

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Unusual Value for Protein-Bound Iodine in the Serum of the Opossum

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Apparently the last comparative study of serum protein-bound iodine (PBI) was made by Taurog and Chaikoff in 1946 (*1*). Since then the analytic procedure has been changed radically (*2*). Moreover, recourse to the *Handbook of Biological Data* (*3*) reveals no information concerning PBI values for the rabbit, the hamster, the sheep, or the opossum. Therefore, it was deemed important that the knowledge concerning, normal PBI values (the easiest obtainable assessment of circulating thyroid hormone) in experimental animals be extended and brought up to date. Our studies reveal that the level of PBI in the serum of the opossum is extremely low. This article is concerned with certain aspects of this result. In addition, the PBI values that we have obtained for the rabbit and the hamster supply information that was previously lacking.

Blood was obtained by cardiac puncture from three monkeys (*Cynomolgus*), four rabbits, 15 rats (Sprague-Dawley), five hamsters (*Cricetus auratus*), three opossums (*Didelphis virginiana*), three white leghorn chickens, and five guinea pigs. Jugular blood was withdrawn from three stallions directly upon slaughter at a local slaughterhouse and from a ewe housed in our animal room. In each case the respective serums were pooled and several analyses (from three to seven) were performed in duplicate upon the specimens, which were stored at 4°C between determinations. All animals were in the postprandial state when examined, and the season was summer. The method of analysis was essentially that of Barker *et al.* (*2*).

Table 1 provides the results of the analyses for PBI in the serums of the various animals used. It can be noted that the opossum serum was strikingly low in PBI. Values found for the rabbit and hamster (two specimens for which values do not appear in the literature) were in the so-called normal range. The values observed for the chicken are in good agreement with those reported by Taurog and Chaikoff (*1*). The concentration of PBI found in the rat serums are in the range noted by Taurog and Chaikoff (*1*), Halmi and Barker (*4*), and Klitgaard *et al.* (*5*). Serum PBI values for the guinea pig and the sheep are in close agreement with those disclosed by Young *et al.* (*6*) and Weeks *et al.* (*7*), respectively. Values for the horse and the monkey are in the range indicated in Albritton's *Handbook* (*3*). Thus it is clear that the technique is reliable and reproducible in our hands. Human blood samples analyzed also gave values in the range noted by Barker *et al.* (*2*) to be normal.

It is surprising to note that the opossum possesses a very low protein-bound iodine level (0.4 μg percent). In the absence of other data in the literature, it is pertinent to note that Hartman (*8*) calls attention to the fact that the body temperature of the opossum is peculiarly low—about 95° to 97°F, as established by Selenka in 1887 and more recently by Wislocki (both referred to by Hartman). Burke (*9*) also found that the rectal temperature of the opossum is about 95°F. Hartman points out that with this body temperature, the opossum alone "fails to fit into the chart of body size-temperature relationship of the animal series from the finger-sized shrew to the elephant" and that there is no explanation for this instance of nonconformity.

Immediately, therefore, one is struck by the association pointed out here between the low PBI values (reflecting a low titer of circulating thyroid hormone) and low body temperature. A comprehensive study of

Table 1. PBI values obtained from the serums of several animals.

Animal	PBI (μg percent)
Horse	3.6 ± 0.4
Monkey	6.0 ± 0.7
Sheep	3.7 ± 0.3
Rabbit	3.3 ± 0.5
Rat	4.5 ± 0.4
Guinea pig	2.5 ± 0.5
Hamster	3.5 ± 0.4
Opossum	0.4 ± 0.2
Chicken	2.6 ± 0.3

thyroid-hypophyseal histology and physiology in the opossum appears to be well worth the undertaking, for the host of questions raised by the afore-mentioned association indicates a fundamental problem of singular importance. Is it possible that there is a low level of hypophyseal-thyroid interaction but that the tissues of this animal are adapted to small amounts of thyroxine so that their efficiency is maintained? (The opossum is sedentary but not sluggish.) Are the oxidative metabolic and enzymatic rates of the tissues of this marsupial different from those of other mammals? Experiments are being designed to elucidate these points regarding the hypothyroid animal with the hope that clues may be provided that might be important in human thyroid physiology.

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Synthesis of Oligosaccharides from Maltose by Rat Liver

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Enzymes that can synthesize oligosaccharides from maltose are known to be present in molds and bacteria. As far as we are aware, no such enzyme system has been shown to occur in animal tissues. Recently, however, it has been shown that an enzyme that can transfer a glucose residue from maltose to flavins (*1*) is present in rat liver. We have observed that the rat liver contains an enzyme system that can convert maltose by transglucosidation into oligosaccharides with simultaneous liberation of glucose.

The enzyme was obtained in an amorphous powder form by fractional precipitation of the liver homogenate with alcohol after the amylase had been removed by adsorption on starch. The fraction obtained between 50 and 80 percent alcohol concentration was centrifuged and was dried with cold acetone and ether. The enzyme (20 mg) was incubated at 37° ± 2°C with 1 ml of 20-percent maltose in 0.02*M* acetate buffer at *p*H 5.0. The progress of the reaction was followed by circular paper-chromatographic technique, as is described by Giri and Nigam (*2*). Figure 1 shows the formation of oligosaccharides from maltose at varying periods of incubation.

Fig. 1. Circular paper chromatogram, showing the synthesis of oligosaccharides from maltose by the enzyme prepared from rat liver. The numbers on the inner circle indicate the time of incubation in hours. Whatman No. 1 filter paper (18 cm in diameter) was used. Developing solvent: *n*-butanol, pyridine, and water (6 : 4 : 3); double development. The reagent used was 2-percent triphenyltetrazolium chloride in water-saturated butanol mixed with an equal volume of *N* alcholic potash. Band 1 indicates glucose; band 2, maltose; band 3, maltotriose; and band 4, maltotetraose.

The two oligosaccharides formed have been identified as maltotriose and maltotetraose; they were identified by our running chromatograms with known reference substances in different solvents and by determining the papergram mobilities. The oligosaccharides yield only glucose on hydrolysis, thereby showing that they contain only glucose units. The two oligosaccharides were isolated by charcoal-celite column chromatography, as is described by Whistler and Durso (*3*), and confirmed as maltotriose and maltotetraose by (i) optical rotation, (ii) partial hydrolysis with 0.1*N* sulfuric acid, (iii) preparation of acetyl derivatives, (iv) periodate and hypoiodite oxidations, (v) hydrolysis by β-amylase, and (vi) priming capacity for phosphorylase (green gram) action. Other disaccharides—lactose, sucrose, cellobiose, and isomaltose—did not show the formation of oligosaccharides. The rat brain homogenate also was found to contain the enzyme.

It is interesting to note that rat liver contains an enzyme system that brings about the synthesis of oligosaccharides containing 1 : 4 glucosidic links only, whereas the mold enzyme systems synthesize oligosaccharides having both 1 : 4- and 1 : 6- glucosidic links. It is probable that the formation of 1 : 4 and 1 : 6 links are caused by the action of two different enzymes.

A more detailed report of this investigation is in preparation.

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Chemical and Biological Studies on 1,2-Dihydro-*s*-triazines. XI: Inhibition of Root Growth and Its Reversal by Citrovorum Factor

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Previous communications have described the synthesis (*1, 2*) of a new family of 1,2-dihydro-*s*-triazines and the microbiological (*3*), antitumor (*4*), and antimalarial (*1, 5*) activity exhibited by the derivatives of this series. Antimalarial activity (*6*) and antiprotozoan activity (*7*) have also been reported from other laboratories. The present report (*8*) concerns the activity of a representative compound—4,6-diamino-1-(3′,4′-dichlorophenyl)-1,2-dihydro-2,2-dimethyl-*s*-triazine (D-54 · HCl) (*1, 2*)—in a turnip seedling system similar to the "Kressewurzel growth test" (*9*).

Seeds of *Brassica rapa* L (*10*) were washed, soaked 2 hr in distilled water at 25°C, and placed in petri dishes on filter paper moistened with 6 ml of distilled water. The dishes were then slanted in racks providing a 45° angle and incubated in the dark at 25°C for 22 to 24 hr. Twenty seedlings with straight roots of equal length (as measured by calipers under magnification) were arranged in one or two rows in the upper two-thirds of petri dishes on filter paper moistened with 5 ml of 6.7 mM phosphate buffer (*p*H 5.9) that contained the various compounds to be tested. Identical control seedlings in dishes with buffer alone were included in each experiment. The tests were incubated as before for 24 hr, and root growth was then measured by placing the seedlings on millimeter graph paper.

The results of a typical experiment with D-54 · HCl and 4-aminopteroylglutamic acid (4-APGA), an analog of pteroylglutamic acid (PGA) known to inhibit plant growth (*11*), are illustrated in Fig 1. The addition of 100 μg/ml of D-54 · HCl to the buffer resulted in marked inhibition of root growth, and lesser concentrations were progressively less effective. The inhibitory activity of D-54 · HCl was considerably less than that of 4-APGA, as is indicated by the inhibition obtained with 2 μg/ml of 4-APGA. The data derived from several such experiments are summarized in Fig. 2, where the mean growth increment of treated seedlings is plotted as a percentage of the mean growth increment of control seedlings, which is designated as 100 percent. The inhibition of root growth by D-54 · HCl, as with 4-APGA, exhibited a linear increase in response to logarithmic increases in concentration of inhibitor.

The 1,2-dihydro-*s*-triazines, like 4-APGA, interfere with the conversion of PGA to citrovorum factor (CF) in bacterial (*3*) and mammalian liver systems (*12*). However, the mechanisms of action of the two classes of inhibitors differ, the 1,2-dihydro-*s*-triazines inhibiting a coenzyme I-dependent system concerned with the biological reduction of PGA (*13*). Thus, in appropriate microbiological systems, reduced PGA (*14*), coenzyme I or its precursors, CF, thymine or thymidine, but not unaltered PGA, reversed D-54 · HCl inhibition (*3, 13*). Accordingly, analogous reversal experiments were conducted with these various metabolites in the seedling system. These experiments were identical with those previously described, except that the metabolites were added to the buffer simultaneously with a constant concentration of inhibitor (10 μg/ml of D-54 · HCl) that resulted in about 50-percent inhibition of the mean growth increment. The extent of reversal was computed by determining the mean growth increments resulting from the addition of a given metabolite to such inhibited systems.

Inhibition by D-54 · HCl (Table 1), like that of 4-APGA in plant systems, was not reversed by PGA (*11*) or a precursor (PABA) but was reversed inconsistently by reduced PGA, partially by nicotinic acid or coenzyme I, and more effectively by CF, thymine or thymidine, as has been observed in bacterial systems. This pattern of reversal is consistent with previous observations, suggesting that, as is the case with certain bacteria, the conversion of PGA to CF in this seedling system involves a coenzyme I—

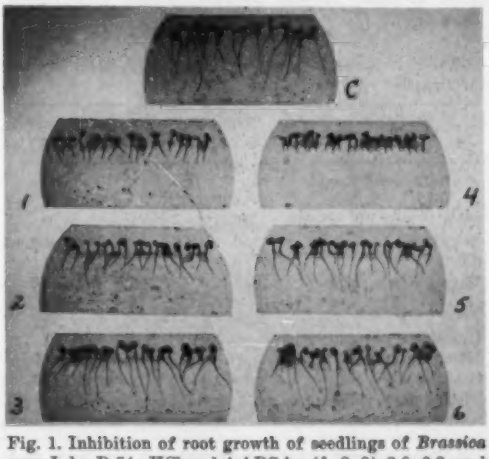

Fig. 1. Inhibition of root growth of seedlings of *Brassica rapa* L by D-54 · HCl and 4-APGA; (1, 2, 3) 2.0, 0.2, and 0.02 μg/ml of 4-APGA, respectively; (4, 5, 6) 100, 10, and 1 μg/ml of D-54 · HCl, respectively; *C*—untreated control.

Fig. 2. Dose-response relationships.

dependent reduction that can be blocked effectively by D-54 · HCl. The reversal of this inhibition by thymine or thymidine indicates that as in bacterial systems, the metabolism of PGA is concerned with the biosynthesis of precursors of nucleic acid.

In other experiments, cytological studies on root meristems of *Vicia faba* seedlings and *Trillium erectum* rhizomes exposed to 0.1 to 0.2 μg/ml of 4-APGA or 1 to 2 μg/ml of D-54 · HCl for 24 hr at 25°C in the dark revealed a marked decrease in the number of cells in normal meta,- ana-, and telophase, and an accumulation of overaged prophase cells. Study of similar roots allowed to recover in distilled water for several hours following such exposure to D-54 · HCl indicated that a significant number of cells had been damaged permanently, as is evidenced by the presence of dying pyknotic cells and aberrant mitoses characterized by "sticky" anaphase bridges. These observations suggest that, like the inhibitory activity of 4-APGA in plant (*11*) and mammalian systems (*15*), the inhibitory activity of D-54 · HCl may be attributed at least in part to interference with normal mitosis.

Table 1. Reversal of D-54 · HCl (10 μg/ml) inhibition of *Brassica rapa* L. seedling root growth.

Metabolite*	Amount (μg/ml)	Reversal (%)
p-Aminobenzoic acid (PABA)	1.0	0
PGA	10–1.0	0
Dihydro-PGA†	10–1.0	Inconsistent
CF	0.02	50
Thymine	8–2.0	15–20
Thymidine	0.8	50
	.2	25
Uracil	2.0	0
Nicotinic acid	1.0	10–15
Coenzyme I	50.0	10–15
Thiamine, pyridoxine, and so forth	0.1	0

* Higher concentrations in most instances were toxic, as is evidenced by inhibition of growth in comparable experiments without inhibitor.

† Prepared in these laboratories by E. J. Modest, after O'Dell *et al.* (*14*). Presumably the 7,8-dihydro-derivative.

These data suggest that (i) CF or closely related structures may be the form in which PGA is active in plant tissue, and (ii) D-54 · HCl interferes with nucleic acid metabolism by inhibiting the conversion of PGA to CF in a manner similar to that described in bacterial and mammalian systems.

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28 February 1955.

Detection of Coronary Atherosclerosis in the Living Animal by the Ergonovine Stress Test

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In studies on cardiac pain (*1*), we became interested in the effects of ergonovine on the coronary circulation in patients with effort angina and a normal resting electrocardiogram. Under these conditions, the ergonovine stress test (*2*) may produce alterations in the electrocardiogram indicative of coronary artery disease. The question arose whether the diagnostic value of this test as noted in man likewise applies to the living animal for detection of experimental coronary atherosclerosis. At present, pathologic changes in the coronary arteries can be ascertained only after sacrificing the animal. Electrocardiograms in the atherosclerotic dog (*3*) and chick (*4*) taken in the absence of additional stress on the coronary circulation have not shown significant abnormalities.

For this study (*5*), adult male rabbits fed a diet that contained 2 percent cholesterol, together with control animals fed a stock diet and maintained under otherwise identical conditions, were used (*6*). Series A comprised 16 rabbits kept on the diets for 11 wk, and series B, 18 rabbits kept for 20 to 22 wk on the diets, as shown in Table 1. The ergonovine stress test was carried out once on rabbits of series A, dur-

Table 1. Correlation of results of ergonovine stress test with atherosclerotic lesions in rabbits on stock and cholesterol diets.

	Series A		Series B	
	Control	Cholesterol	Control	Cholesterol
Weeks on diet	11	11	20–22	20–22
Rabbits	7	9	7	11
Weight (avg. kg)				
Start of diet	1.23	1.24	1.62	1.64
End of diet	2.03	1.83	2.28	2.05
Aortic atherosclerosis				
Thoracic } avg. degree	0.06	0.83	0	3.80
Arch } avg. degree	0.21	1.30	0	4.00
Coronary atherosclerosis				
No. rabbits	0	1*	0	11
Myocardial damage				
No. rabbits	0	0	0	11
Ergonovine test positive				
No. rabbits	0	0	0	11

* One rabbit showed a small atherosclerotic plaque, which did not compromise the lumen.

ing either the eighth or tenth week. In series B, four such tests were made on each rabbit at 7, 12, 16, and 20 wk, respectively, and a fifth test was made at 22 wk on rabbits still alive at this time. The last ergonovine test was made within a few days of sacrifice, except in one animal in which the interval was 4 wk. Electrocardiograms (leads II and IV) were taken (*7*) during pentobarbital anesthesia (10 to 20 mg/kg intravenously) just before and at intervals of 1, 3, 5, and 10 to 15 min after intravenous injection of ergonovine maleate (*8*). In series A, at each test two doses of ergonovine were used, 0.05 and 1.0 mg/kg, respectively, given about 15 min apart. In series B, only the smaller of these doses was given; in terms of body weight, this represents 10 to 30 times the dose similarly used for the ergonovine test in man.

Blood was drawn for total cholesterol determination (*9*) just before sacrificing the animal. The degree of aortic sclerosis was evaluated grossly according to an arbitrary scale of 0 to 4 (*10*). Hearts were fixed in 10 percent formalin, and in each case two cross sections, one near the base and one near the center, were studied microscopically. Blind test precautions were observed in the collection and analysis of data.

The results (Table 1) show a striking correlation of electrocardiographic changes after ergonovine with the presence of coronary atherosclerosis. In the nine cholesterol-fed animals of series A, after about 2 mo on the diet, significant pathologic changes in the coronary vessels were absent, and there were no electrocardiographic abnormalities. In contrast, there was extensive atherosclerosis of the thoracic aorta, and the serum total cholesterol showed on the average a 35-fold increase over that of the control animals.

In the 11 cholesterol-fed rabbits of series B, after 4 to 5 mo on the diet, there was extensive occlusive atherosclerosis of the small coronary arteries with myocardial damage (Fig. 1), and the ergonovine stress test became positive. Positivity was indicated by a drug-induced depression of the S-T segment of 0.5 mm or more below the isoelectric level (lead II or IV). After ergonovine injection, the S-T depression usually developed progressively and was most marked at the 5 or 10 to 15 min interval. After 20 or 22 wk on the cholesterol diet, a few animals showed spontaneous S-T depression before ergonovine, which was always intensified by the drug (Fig. 2).

Other effects of the high-cholesterol diet were an elevation of the serum total cholesterol and extensive lipidosis of the abdominal organs and the sclerae. The pathologic changes in the heart were similar to those previously described by Anitschkow (*11*). No control animal showed either coronary atherosclerosis or a positive ergonovine test.

Experiments are in progress to determine how early in the course of coronary atherosclerosis the ergono-

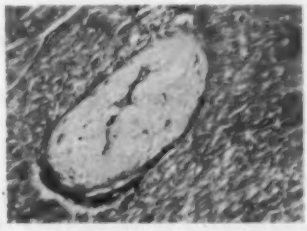

Fig. 1. Atherosclerosis of small coronary artery, rabbit No. 6, after 20 wk on cholesterol diet. Lipid-laden foam cells in intima practically occlude lumen. Upper right of field, myocardium shows spotty hyaline degeneration. (Hematoxylin-eosin × 200)

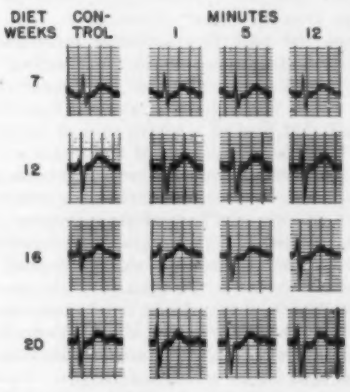

Fig. 2. Serial ergonovine stress tests made at monthly intervals on same cholesterol-fed rabbit as in Fig. 1. Lead II is shown. "Minutes" refers to time after ergonovine injection. Test becomes unequivocally positive after 16 wk on diet, as is clearly seen in the tracing taken at 12 min. After 20 wk on diet, control electrocardiogram becomes abnormal and depression of S-T segment is intensified by ergonovine. (Sanborn twin-beam electrocardograph, paper speed 75 mm/sec)

vine stress test becomes positive and to standardize the technique for the test in the rabbit.

In summary, data in the cholesterol-fed rabbit show marked correlation of positivity of the ergonovine stress test with occlusive atherosclerosis of the small coronary arteries and myocardial damage. It is suggested that the ergonovine stress test may provide a new experimental procedure for the study of coronary atherosclerosis in the living animal. The data are in accord with the previously reported correlation of a positive ergonovine test with clinical evidences of coronary artery disease in man.

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5. This investigation was supported by grants from the National Heart Institute, National Institutes of Health, U.S. Public Health Service, grant No. H493(C5), and the Josiah Macy, Jr., Foundation. The technical assistance of Diana Charleson is gratefully acknowledged.

6. These rabbits were made available to us by Herald Cox, department of viral and rickettsial research, Lederle Laboratories, Pearl River, N.Y.
7. Tracings were taken on each animal with both the Sanborn visocardiette and twin-beam electrocardiograph.
8. Supplied by Burroughs-Wellcome Co., Tuckahoe, N.Y.

9. Acknowledgment is made to J. B. Logan, Lederle Laboratories, for the determinations.

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2 March 1955.

Communications

Isolation of Anaerogenic *E. coli* 026:B6 Serotype from a Case of Calf Scours

The *Escherichia coli* serotypes most commonly associated with infantile gastroenteritis are 0111:B4, 055:B5, and 026:B6. The latter two serotypes have been reported in case of animal diarrheas. Ørskov (*1*) and Smith (*2*) identified three fermentation types of the *E. coli* 026:B6 group that were isolated from autopsies of newborn calves that died from calf (white) scours. Fey (*3*), isolated *E. coli* 026:B6 from calves suffering from septicemia and dysentery and from cattle with mastitis. Ulbrich (*4*) reported the 055:B6 serotype from fatal cases of scours.

During the past year extensive investigation (*5*) of coliform strains present in the intestinal tract of healthy and diseased calves has been undertaken. One strain, 125M, was isolated at autopsy from the ileum of a calf that died of a severe case of scours.

The biochemical reactions of this strain were determined by inoculating phenol red broth containing 0.5 percent of the sugars and incubating for 96 hr at 37°C. Acid only was formed from dextrose, lactose, maltose, mannitol, xylose, arabinose, sorbitol, and sucrose. Adonitol, dulcitol, rhamnose, and inositol were not fermented. The reaction in salicin was variable. The methyl red and indole tests were positive, while Voges-Proskauer, citrate, and urea reactions were negative. Nitrite was reduced to nitrate but hydrogen sulfide was not formed.

The serological typing of the original culture (125M) and a culture (204D) isolated after successful calf passage was carried out by W. H. Ewing of the Communicable Disease Center, Chamblee, Georgia. Both cultures were reported as the anaerogenic *E. coli* serotype 026:B6.

Several successful passages in young calves have been made. The culture produced a fatal case of scours in three calves when it was fed to them by mouth. Control calves raised under the same management conditions remained normal.

This strain of *E. coli* is identical, biochemically and serologically, with Ørskov's anaerogenic type 3 (*1*) and is believed to be the first reported in calves outside of Europe.

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4 March 1955.

Use of Centralized and Departmental Libraries in College and University Geology Instruction

Three years ago I sent a questionnaire to 88 geology departments in the United States and Canada asking whether centralized or departmental library facilities were preferred and why. The same study has been made in chemistry by Broberg and Dunbar (*1*) with similar results.

I received 80 answers, a good return on my questionnaire, with the last questionnaire coming in a year and a half ago (*2*). In spite of my delay in reporting the results, I feel that the data are still generally valid and, hence, should be presented now.

The questionnaire included the items in sections 1 to 4 of Table 1. The data in section 5 were compiled from answers to sections 1 to 4 and to the following

Table 1. Summary of information gathered from questionnaires (*4*).

Question	0–25 geology majors				26–100 geology majors						100 geology majors				Totals	
Section 1 Total enrollment of school	< 2000		2000–10,000		< 2000		2000–10,000		> 10,000		< 2000	2000–10,000	> 10,000			
Public or private support for school. (Numbers show number of schools; letters indicate items as plotted on graph)	Pub. (3) (a)	Pri. (7) (b)	Pub. (4) (c)	Pri. (4) (d)	Pub. (5) (e)	Pri. (2) (f)	Pub. (14) (g)	Pri. (11) (h)	Pub. (5) (i)	Pri. (5) (j)	Pub. (1) (k)	Pub. (9) (l)	Pub. (8) (m)	Pri. (2) (n)	Pub. (49) (o)	Pri. (31) (p)
Section 2																
All materials in main library	1	2	1		2		5	1			1	3	1		14	3
More than half of materials in main library	1	1	2	1	1	1	2	4	1			1			8	7
Less than half of materials in main library	1		1	2			4	3	2	4		1	4	1	13	10
All materials in departmental library		3		1	2	1	3	3	2	1		4	3	1	14	10
Section 3																
Prefer materials in main library	1	1	1		1		5	1			1	1	1		11	2
Mostly in main library	1	1	1	1		1	1					1			4	3
Mostly in departmental library		2	2	2	1		3	4	3	1		2	2		13	9
Prefer materials in departmental library	1	3		1	2	1	5	5	2	4		5	5	2	20	16
Section 4																
Central library recommended by survey		1						1				1			1	2
Departmental library recommended by survey				1								2	1		3	1
Section 5																
Departmental library favored and used	1	3	1	2	2	1	8	7	4	5		6	7	2	29	20
Departmental library favored but not used	2	1	1		1		2	1	1			2			9	2
Science division library favored or used		1		1	1		1	2							2	4
Central library favored and used		2	2	1	1	1	3	1			1	1	1		9	5

statement: "If you particularly favor departmental libraries over centralized libraries in geology, or vice versa, and care to note your reasons, please do so."

Table 1 lists the types of libraries, number of geology majors, and total enrollment in the school, as well as whether the school is publicly or privately supported. In most categories the preference is for departmental libraries. The preference and/or use of centralized libraries is most common in schools with small total enrollment and/or small number of geology majors, as is shown by the graph in Fig. 1. An important variable not considered in the questionnaire is the distance from the library to the geology department. One reason for centralized library preference was the nearness of the library building to the geology department; in several instances geology was in the same building as the library. Conversely, several answers quoted the long distance to the main library as a reason for departmental libraries.

Some of the reasons given for preference of centralized libraries include the following (*3*). (i) The general integrated undergraduate courses in small colleges require access to books in several fields, and this is hindered if the books are scattered in departmental libraries. (ii) Centralized libraries reduce book losses, are more convenient, and give better service over a longer day. (iii) No room is available for departmental libraries, and no funds are available to staff them. (iv) Duplication of staff and materials is reduced. (v) Materials in allied fields are more readily available.

Some of the reasons given for preference of departmental libraries include the following. (i) They are more convenient and save staff and students much time. (ii) The availability of departmental libraries encourages students to browse through books and journals in their spare time. (iii) Research laboratories and library form a unit that cannot be divided

Fig. 1. Comparison of the number of geology departments that have departmental libraries with the number of geology departments that have other types of libraries. Grand total of 80 schools, q; all other letters are explained in Table 1.

without loss. (iv) The informality and convenience of departmental libraries promotes investigation and research. (v) Departmental libraries bring together scattered references in a field of study and increase efficiency.

In summary, 75 percent of the 80 schools that answered the questionnaire have departmental libraries or favor them. Schools with centralized libraries total 17½ percent, and schools with science division libraries total 7½ percent. No school with a departmental library indicated a preference for a centralized library, but one had shifted in the past to a centralized library because of book losses.

If the main university library is near the geology department, or if funds are not available for departmental libraries, a centralized library is preferred. If the campus is large, and/or if the geology department has a large faculty and graduate school, a departmental library is usually preferred, but there are a few notable exceptions. Convenience and time saved were the main arguments for departmental libraries. Most schools specified that departmental libraries must be properly staffed. Some schools report that science division libraries are very satisfactory. No conclusions can be drawn from the results of the very few library surveys that have been conducted by library experts.

It is my conclusion that, inasmuch as libraries exist chiefly to serve students and faculty, they should be located where they will serve best. If funds are available, the location will generally be in the department.

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2. I wish to thank everyone concerned for the fine response.
3. Permission to quote by school name was given in most of the questionnaires, but lack of space precluded complete quotations.
4. In some instances the questionnaires were not filled out completely. Therefore the number of answers may not equal the number of schools.

24 March 1955.

Some Aspects of State Academy of Science Publications

More than 50 years ago, J. McKeen Cattell made the following remarks concerning academy publications as a whole (*1*).

> Proceedings and transactions were an important function of an academy of the eighteenth century, but there is no longer any excuse for presenting researches on utterly diverse subjects in one volume, because the authors happen to be members of the same academy. We might as well make up volumes according to the cranial index of the contributors. The national society for each science should directly or indirectly have charge of the publications of that science.

Although these words have been generally ignored, it is especially unfortunate that this bibliographic schizophrenia still exists in many journals of limited audience at the state academy of science level.

Subsequent writers (*2–8*) have concerned themselves with what should be included in the journals or with the mechanics or encouragement of publication and have taken it for granted that the academy should have its "transactions." That there are now about 35 academies sponsoring publications indicates the apparent importance of this feature of an academy's activities.

Little in the way of comparative study has been done to evaluate the position of these journals in scientific literature. Yet their value could be gaged in part by the quality of papers that academy members submit to each academy journal, as compared with the articles that they send to other journals. Not long ago, I had an opportunity to examine recent consecutive volumes of 30 academy publications with respect to contents, format, frequency, and other details. Among the journals containing original papers, three groups may be distinguished: (i) the irregular journal devoted exclusively to full-length papers, (ii) the usually annual journal containing both transactions and original papers or abstracts of papers given at the annual meeting, the "typical" academy journal, and (iii) the quarterly or bimonthly journal having some or all the earmarks of a general science periodical. The features of the third group, which is composed of relatively newer publications, indicate a possible trend toward a more modern approach in presenting science to the citizen of the state.

Considering the contents of the 30 publications, of

37 diverse subject fields represented, only the following were so frequent as to comprise at least 10 percent of a journal's contents: zoology, 24 journals; botany, 15; chemistry, geology, 9; agriculture, 7; education, 5; forestry, physics, 4; biochemistry, mathematics, psychology, 3; conservation, medicine, geography, history, 2; nutrition, physiology, biology, language and literature, 1. That these frequencies do not correspond very closely with the fields of most interest of academy members as recorded by Bevan (*9*) is apparently due to the inherent qualities of each discipline (for example, its adaptability to local interpretation, the need for elaborate equipment to pursue the science, its appeal to amateurs) or to other factors. Thus it appears that many academy journals still serve to a large extent as vehicles for the publication of papers in zoology and botany at the expense of the other sciences, as was early recognized by Bayley (*5*).

Whether or not academy papers are, in effect, buried in libraries and in the literature of science depends upon the comprehensiveness of the abstracting or indexing in a particular subject field. Table 1 lists major bibliographies and indexes that include academy journals in their lists of periodicals received and gives the number of academy publications processed by each. Of course, these lists may vary from year to year and for each service depending upon its editorial policies and facilities and upon the availability of the journals analyzed and the suitability of the articles included in them. These points should be considered by the academy member who desires to have a paper printed in his state academy journal, if he is at all concerned with its ultimate audience.

While there are some academies with excellent scientific journals, it might be suggested that in other cases (for example, where an academy publication is in a comatose or moribund condition, or in academies where members need to be cajoled into submitting papers) the committee in charge of publications should reevaluate its journal in terms of what it could be doing to satisfy the objectives of a *modern* state academy of science. Upon comparing their journal with other scientific periodicals, they might well decide that the time had arrived to heed Cattell's remarks, and that an improved newsletter or a more efficient means of publication (*10*) would serve a better purpose than a poorly indexed journal spread thin over an encyclopedic range of subjects.

Table 1. Number of state academy publications analyzed by abstracting and indexing services (maximum number for 1–5-yr period).

Number	Analyzing service
28	*Bibliography of Agriculture*
25	*Chemical Abstracts*
25	*Annoted Bibliography of North American Geology*
23	*Biological Abstracts*
9	*Annoted Bibliography of Economic Geology*
8	*Chemisches Zentralblatt*
7	*Psychological Abstracts*
7	*Bibliographic Index*
6	*Mathematical Reviews*
3	*Index Medicus*
2	*Physics Abstracts*
2	*Engineering Index*

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2. T. C. Mendenhall, *ibid.* **42**, 881 (1915).
3. D. D. Whitney, *ibid.* **50**, 517 (1919).
4. P. P. Boyd, *ibid.* **51**, 575 (1920).
5. W. S. Bayley, *ibid.* **57**, 623 (1923).
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7. G. E. Johnson, *ibid.* **76**, 373 (1932).
8. C. A. Browne, *ibid.* **84**, 1 (1936).
9. A. Bevan, *Sci. Monthly* **73**, 257 (1951).
10. See C. F. S. Sharpe, *Science* **92**, 403 (1940).

31 March 1955.

Book Reviews

Protozoology. Richard R. Kudo. Thomas, Springfield, Ill., ed. 4, 1954. xi + 966 pp. Illus. $10.75.

The fourth edition of this basic textbook was developed to keep pace with currently expanding research activity involving the Protozoa. In the span of 25 years since the appearance of the first edition, this work has become the standard American reference handbook on protozoan systematics and morphology. As an outgrowth of the author's long career as a teacher, the book has been directed toward college and graduate students who desire an introduction to protozoology.

Each edition has been marked by an expanding treatment of general biological topics (for example, sexuality, heredity, ecology, nutrition, general physiology), culminating now in an imposing book of 966 pages (778 pages in the 1946 edition, 451 pages in the first edition). The 376 text figures are of uniformly fine quality and include four colored plates and several halftones. Usefulness of the text is heightened by inclusion of separate author and subject indexes, along with an enlarged bibliography at the end of each chapter that thoughtfully includes the titles of all papers cited.

The basic organization of the book is unchanged. The first section (246 pp.) treats general aspects of protozoan organization, ranging through comparative morphology, ecology, physiology, reproduction,

and heredity. This is followed by a larger section (631 pp.), containing an intensive survey of the individual taxonomic groups. In each case this survey begins with a characterization of the group and extends through definitions of representative species of each genus; a running taxonomic key is helpful in separating forms within each group. Special effort has been devoted to insure adequacy of treatment of parasites without restriction to those of concern to medical parasitology. A terminal chapter (25 pp.) presents a compact, useful outline of methods of collecting, cultivating, and staining protozoans.

Each student will have his own opinion of the adequacy of particular portions of the text. Some may be disturbed by the failure to modify the taxonomic system itself in light of recent, well-documented proposals by Fauré-Fremiet for the entire ciliate assemblage and by Kirby for the morass of animal flagellates. Others may regret the failure to include Lowndes' fundamental analysis of flagellate locomotor mechanisms and, on a still more physiological plane, may decry the absence of a clearer exposition of our present knowledge of protozoan nutritional patterns. In a few places minor errors have crept in, such as the failure to distinguish between the blepharoplast and kinetoplast of hemoflagellates.

The fact remains, however, that the present edition incorporates solid improvements and still further strengthens the outstanding value of this textbook as an introduction to the structural organization of the Protozoa.

WILLIAM BALAMUTH

Department of Zoology,
University of California, Berkeley

The Pineal Gland. A review of the physiologic literature. Julian I. Kitay and Mark D. Altschule. Published for the Commonwealth Fund by Harvard Univ. Press, Cambridge, Mass., 1954. xiv + 280 pp. Plates. $5.

In many quarters, particularly in America, the function of the pineal body is generally assumed to be unknown. For example, in Maximow and Bloom's widely used *Textbook of Histology* (Saunders, 1952, ed. 6), the question is summarized as follows.

> Unfortunately, extirpation and injection of extracts of the organ have given inconstant and highly contradictory results. Typical secretory granules are not found in specific pineal cells.

In their book Kitay and Altschule subject this belief to a critical examination by analyzing statistically the widely scattered physiological literature on pinealectomy, pineal-extract administration, and pineal implantation in various animals (mainly frogs, chicks, rabbits, mice, and rats). As a further means of appraising the question of pineal function, they reexamine the clinical evidence that indicates a possible correlation between pineal tumors and changes in the genital system of boys.

Analysis of the experimental data, the most reliable and best controlled of which have appeared in recent years, supports the conclusion that pinealectomy affects the genital systems, causing gonadal hypertropy, acceleration of vaginal opening in immature rodents, and prolongation of estrus with shortening of diestrus in mature rodents. Contrariwise, pineal-extract administration produces gonadal atrophy, retards vaginal opening, and inhibits the action of pituitary gonadotropin. Pineal extracts are also said

> . . . to inhibit changes in blood chemistry that are consistent with the action of corticotrophin and the adrenocortical hormones; they also decrease 17-ketosteroid excretion.

The evidence of correlations between the pineal body and other endocrine glands is said to be inconclusive, as are also effects of the pineal on body growth and development. Pineal-extract administration is reported to cause statistically significant elevations in blood glutathione in psychotic patients as well as a marked decrease in hyperketonuria caused by stress of surgical operation. Unfortunately, the authors do not inquire or attempt to establish whether these "statistically significant" effects of the administration of "extracts" are *biologically significant* or *specific in character.*

Since the inquiry is confined to a statistical analysis of selected physiological data, no mention is made of possible physiological implications of the observed age involution of the human pineal gland or of the fact that in some vertebrates, including several groups of mammals, the pineal body is rudimentary. Nor are the neural connections of the brain and pineal body considered with respect to the changes following pinealectomy.

The second part, entitled "Clinical correlations," concerns a syndrome of precocious puberty seen in boys. This was first described half a century ago by Marburg, who ascribed it to decreased secretion of the pineal gland, associated with pineal tumors. The present authors claim that this syndrome is associated strictly with pineal tumors composed of nonparenchymal cells, whereas tumors consisting of parenchymal cells are not accompanied by any genital disorder. They attribute the induction of the genital syndrome to the suppression or replacement of the specific parenchymal cells by nonparenchymal (neuroglial) elements with an associated decrease in the inhibition that the pineal body normally exerts in some manner on the male gonads. Although Kitay and Altschule offer no explanation for the failure of such tumors to induce sexual precocity in girls, they regard the clinical findings as consistent with the results obtained experimentally in animals. In view of the importance of the issue of two different kinds of tumors, it is to be regretted that typical histopathological illustrations of them are not included. Such pictures might well have replaced the book's frontispiece, which is a poorly defined, colored reproduction of a histological section (bearing the caption "Pineal gland [presum-

ably normal] of a forty-six year old woman") which reveals nothing of consequence.

Fully two-thirds of the volume consists of a bibliography of some 1800 references cited by titles. Six hundred of these have nothing to do with the subject but are references to the anatomy, embryology, histology, and physiology of various other structures that comprise the parietal region of the vertebrate brain (paraphysis, pineal eye, subcommissural organ, and the habenular ganglion and commissure). They were probably included for the sake of completeness, but since they are for the most part written in foreign languages, including Japanese, they afford little information for the average reader.

This book succeeds, to some degree, in dispelling the current belief that the pineal body is functionless. In the rabbit and several rodents at least, it seems evident that the pineal body does exert an inhibitory influence on the gonads and accessory reproductive structures. The nature of this control and its possible interplay with various endocrine and neurohumoral mechanisms remains totally concealed. The sexual precocity encountered in boys in the presence of some kinds of pineal tumors suggests that in man the gland may play a similar role.

GEORGE B. WISLOCKI
Department of Anatomy, Harvard Medical School

K* (*Krebiozen—Key to Cancer?). Herbert Bailey. Hermitage House, New York, 1955. viii + 312 pp. $3.50.

A few years ago Stevan Durovic, a Yugoslav refugee physician working in Argentina, extracted a substance from the blood of cattle that he thought was produced by stimulation of the reticuloendothelial system. This substance, tested in a local clinic, was encouraging in the treatment of hypertension and, under the name of Kositerin, was brought by Durovic to the United States for further clinical testing.

Later Durovic revealed that at about this same time, working in secret, he had discovered that, by injecting horses with extracts of the fungus *Actinomyces bovis*, he was able to stimulate in the host the production of a growth-regulating substance that, according to this hypothesis, would be effective in cancer control. Only 2 grams of the substance, later named Krebiozen, was obtained from 10,000 gallons of horse blood. Initial tests of Kositerin in hypertension proved disappointing.

Durovic then presented to the distinguished physiologist, Andrew C. Ivy, at that time a vice president of the University of Illinois, the problem of determining whether Krebiozen was effective in causing the regression and possible eradication of tumors. This was in the summer of 1949. Late in 1950 all the remaining supply of Krebiozen was placed in about 200,000 ampules with mineral oil, making a satisfactory chemical analysis of it difficult or impossible. In March 1951, Ivy assembled the available data on 22 patients into a brochure entitled "Krebiozen: an agent for the treatment of malignant tumors," and set a date for the announcement of the drug to a group of 80 persons, including physicians and newspaper writers.

The events since that time have been exceedingly confused and controversial. The author of this book presents the case for the substance, Krebiozen, and for Ivy, Durovic, and their friends. It is interestingly written, apparently primarily for the layman. It presents the thesis that Krebiozen and Kositerin existed as two substances, that its backers deplored and attempted to prevent the early newspaper publicity, and that they were persecuted by certain officials of the American Medical Association, the organization that has prevented effectively the further testing of the drug.

In discussing the failure to seek a patent, the author seems unaware that it is the practice of pharmaceutical manufacturers in the United States to reveal to clinical investigators, in confidence, as much as is known concerning the origin, composition, and actions of new drugs prior to their study in patients.

It is of some interest that the early cases responded, if at all, to a single ampule of the drug, but the dose was increased to an average of 80 ampules in a later series of cases treated by Ivy. Also there was a gradual shift of emphasis from the carcinostatic action of the drug to its analgesic or euphoric action. Failure to obtain tumor regression often is accredited to inadequate dosage, and success often is measured in terms of lack of pain until death.

Obviously this book presents only a part of this controversial subject.

PAUL K. SMITH
Department of Pharmacology, George Washington University

Elements of Ecology. George L. Clarke. Wiley, New York; Chapman & Hall, London, 1954. xiv + 534 pp. Illus. $7.50.

Academic ecology has been slow in maturing. The student who elects the subject in an American university may spend most of his time bird-walking, or on the other hand he may at once be put to testing Pütter's hypothesis. One suspects that the field will become set in pedagogic molds only after drastic subdivision; meanwhile student transcripts make common currency of all sorts of odd experiences because they bear the name *ecology* in the catalog.

In this book George L. Clarke has made a helpful contribution toward the averaging of current views on what should go into a course in general ecology. It was his purpose "to bring together in one place and in a simple way the elements of ecology with special emphasis on the modern viewpoint of the science." The first chapter gives definitions and a statement of the divisions and scope of the subject. After this come 286 pages (seven chapters) describing the physical and chemical constitution of the environment, with varying amounts of illustration of

the biological effects of the factors considered. There follows a 48-page section on population ecology (intraspecific relationships). The next 100 pages treat interspecific relationships, the community, and succession and fluctuations. Trophic levels, productivity, and the ecosystem concept are taken up in the final 42 pages.

I would call the balance among the major elements adequate, since balance in an ecology course is largely a matter of personal leaning anyway. I regretted some missed opportunities to offer concrete examples of physicobiological interplay—there are not enough animals in the book to satisfy me. There are a number of statements with an oddly anthropocentric cast, especially in the preface; and some may believe that there is a disproportionate use of examples from the marine environment. Such criticism as this is mostly personal bias, and so, perhaps, is my notion that the idea of the life-web should have been developed at the earliest possible opportunity, and that the section on the community should have been expanded, because the community is the smallest closed interspecific system and the best place in an ecology course to show the reality and intricacy of life-web operations.

The book is admirable in its general rejection of the dreadful jargon of ecology. A disappointing feature is the failure to pare, integrate, and set logical bounds to the intractable subject treated. The execution or reproduction of a few of the illustrations is inferior. Otherwise the book is sound and informative and reflects the wide experience of the author and his long conviction that there really is a teachable ecology of the land, sea, and fresh waters.

ARCHIE CARR
Department of Biology, University of Florida

Der Scharlach und seine Behandlung. W. Pulver. Hans Huber, Bern–Stuttgart, 1954. x + 209 pp. Illus. Paper, DM 19.80.

This thoroughly documented volume, by the chief of medicine at the Kantonspital of Lucerne, reviews the complex problem of scarlet fever and its treatment and reports Pulver's experience in treating more than 700 cases of scarlet fever with penicillin during a period of eight years. Basing his conclusion on the successful results obtained with penicillin, Pulver emphasizes the paramount significance of group AB-hemolytic streptococci in the etiology of scarlet fever. Treatment with penicillin leads in a few days to the disappearance of the organisms from nasal and pharyngeal swabs, and most cases of scarlet fever take a much milder course.

The author believes that scarlet fever serum should be employed only in very severe and moderately severe cases in combination with penicillin. In such cases the serum is employed as an antitoxin. According to Pulver, the most recent type of depot penicillin—he refers specifically to Bicillin—has simplified and improved the treatment of scarlet fever. He deals extensively with the prevention and successful treatment of the complications of the disease by means of penicillin. Noteworthy is his conclusion—this treatment reduces not only the complications caused by bacteria but also sequelae resulting from allergic reactions. A prerequisite for success is early and active treatment with penicillin over an adequate period. Treatment should be coupled with strict isolation.

Although the American reader will not find anything remarkably new in this volume, it does offer a good picture of progressive thought and practice concerning scarlet fever in the German language area. The author has collected a bibliography of 520 references that will be useful to anyone interested in the subject. There is also a subject index.

GEORGE ROSEN
School of Public Health, Columbia University

The Psychological Variables in Human Cancer. Symposium presented at VA Hospital, Long Beach, Calif., 23 Oct. 1953. Joseph A. Gengerelli and Frank J. Kirkner, Eds. Univ. of California Press, Berkeley, 1954. 135 pp. Illus. $3.

This is the report of a symposium presented at the Veterans Administration Hospital in Long Beach, Calif., at which were presented and discussed six papers having to do with the effects of emotional attitudes on the genesis of cancer or the longevity of cancer patients. Three papers present theoretical considerations, one presents case material anecdotally, and another presents work in progress, but not sufficiently advanced to permit conclusions, on autonomic functions in neoplastic diseases.

The major presentation, "Results of the psychological testing of cancer patients," by Eugene M. Blumberg, reports work done to test the clinical hunch of Frank Ellis and Philip West that longevity and responsiveness to treatment are related to psychological factors. A group of 50 patients with miscellaneous advanced cancers were studied by means of the Wechsler-Bellevue, the Minnesota Multiphasic Personality Inventory, and Rorschach tests. By the use of certain scores of the MMPI, Blumberg concluded that

> . . . characteristics of the fast cases are greater defensiveness, more anxiety, and less ability to release tensions through motor discharge, either verbal or physical, when compared to the slow cases. Defensiveness is representative of the patient who is motivated to appear "good" and refers to his motivation to give an impression that he is less disturbed than he really is. . . . The fast cases show an inability adequately to defend themselves against anxiety or successfully to reduce their tensions through action.

There are many points of question in this paper. (i) It is "76 percent accurate" in prediction for "fast cases," but only 54.5 percent accurate in slow cases. (ii) No attempt was made to control the inherent variations of behavior in cancers of different sites. (iii) The antichymotrypsin and antirennin relationship in the blood serum is by no means generally accepted as an accurate indicator of disease activity.

(iv) No attempt was made to control the impact of the disease process or the knowledge of the diagnosis on the various individuals. It is stated that the patients were given time to adjust to this knowledge. The criteria of "adjustment" are not given. (v) No allowance is made for the impact of previous surgical or other therapeutic procedures or for the family or social setting. (vi) There is an assumption made, not clearly justified, that the factors selected in the MMPI indicate anxiety. High scores on the factors selected are classically used to indicate a hysterical syndrome rather than anxiety, and indeed hysteria may function to diminish anxiety. "Defensiveness" was evaluated by a scale that merely taps attitudes toward taking the test, and the inferences are apparently applied to many other or all life-experiences.

Outlining psychological factors operative in either the cause or the course of cancer presents problems of enormous magnitude, since medical ignorance in both oncology and psychiatry are monumental. Attempts by West, Ellis, Blumberg, and the others are praiseworthy, but they have not demonstrated their findings beyond question. The foreword to this volume states:

> The subject is a difficult one and particularly liable to misinterpretation and error. It is of the utmost importance that findings of this very vital area of investigation be subjected to careful scrutiny. Therefore, data reported here should be looked upon as in the nature of preliminary results subject to future corroboration and in a new and growing field of research rather than as secure findings ready for clinical exploitation.

Although this volume does not live up to its title, it should certainly stimulate further research in this area.

ARTHUR M. SUTHERLAND
Department of Psychiatry,
Memorial Hospital, New York

Progress in the Chemistry of Organic Natural Products. (*Fortschritte der Chemie organischer Naturstoffe*). vol. 11 (in English and German). L. Zechmeister, Ed. Springer, Vienna, 1954. viii + 457 pp. Illus. Paper, $17.20; cloth, $18.

The 11th volume of the *Fortschritte der Chemie organischer Naturstoffe* is a continuation of the excellent series started in 1938. Its success can be attributed in great measure to the efforts of its editor, L. Zechmeister, whose influence and wide scientific contacts enable him to convince eminent organic chemists and biochemists throughout the world of the need to contribute articles on the advances in their special fields. Since the *Fortschritte*, containing contributions from many countries, is printed and published in Austria in three languages and is edited in the United States, it can be considered truly cosmopolitan in character. Of the eight articles in the present volume, two come from Germany, two from the United States, two from Australia, one from North Wales, and one from Switzerland.

Inasmuch as the subject matter differs widely and a critical appraisal by one person is not possible, I have limited myself to a brief review of the contents of each chapter.

The first article by S. Peat, entitled "Starch," is a comprehensive review of the recent developments pertaining to the structure and synthesis of this important carbohydrate. A major part of the discussion is devoted to its biochemical aspects. The role of the various enzymes involved in synthesis and degradation of the starch fractions, amylose and amylopectin, and the mechanisms of their formation are thoroughly discussed.

The chapter on "Neuere Ergebnisse auf dem Gebiete des Lignins und der Verholzung," by K. Freudenberg, deals with the constitution and origin of lignin that occurs in great abundance in nature. The author is concerned with the problem of whether lignin is a mixture of a number of related components or whether it constitutes a single polymer built from an elementary unit according to a definite plan, similar to starch or cellulose from glucose. He believes that the experimental evidence is in favor of the latter assumption.

Under the topic of "Probleme und neuere Ergebnisse in der Vitamin D-Chemie," Von H. H. Inhoffen and K. Brückner are concerned with the chemistry of precalciferol (a new isomer in the series of irradiation products of ergosterol), the constitution of vitamin D_2, the tachysterols, and other aspects of vitamin-D chemistry.

The chapter "Natürlich vorkommende Chromone," by H. Schmid, is a compilation of the chromones (derivatives of benzo-γ-pyrone, mostly colorless compounds), which occur naturally in many plants.

In an admirable review, "Configuration of polypeptide chains in proteins," L. Pauling and R. B. Corey discuss the recent achievements in the determination of structure of amino acids as related to proteins. They consider the problem of the configuration of polypeptide chains, their helical and layer configurations as revealed by x-ray studies, and the developments in the determination of the sequence of amino acid residues in the protein molecule. The review is illustrated with numerous excellent diagrams and models, showing the configuration of the atoms in space.

The subject of "Column chromatography in the study of the structure of peptides and proteins" is well summarized and detailed by W. A. Schroeder. The following broad aspects are reviewed: (i) the separation of amino acids and the determination of the amino acid composition of peptides and proteins; (ii) the determination of amino acid sequence in proteins in terms of identification of terminal residues and of the fractionation and identification of peptides; and (iii) the separation and purification of proteins themselves.

R. Lemberg's article on "Porphyrins in nature" deals with the structure, occurrence, and biosynthesis of porphyrins, and A. Albert's article concludes the volume with a discussion of "The pteridines." Albert

notes that only three naturally occurring pteridines were known in 1945 and now as many as a dozen can be counted. They are considered to have an important function as regulators of cell division.

All the chapters contain extensive bibliographies, varying from 106 to 262 references.

In these days with the constant increase in the volume of literature, when time required for covering original papers is so great, authoritative and lucidly presented reviews such as these become increasingly more valuable.

W. Z. HASSID

Department of Plant Biochemistry, University of California, Berkeley

A Budget of Paradoxes. Augustus De Morgan. Unabridged republication of ed. 2 (1915) edited by David Eugene Smith, with a new introduction by Ernest Nagel. Dover, New York, 1954. xxvi + 789 pp. $4.95.

This well-known, remarkable collection of some "400 classic examples of scientific logic gone haywire, gleefully collected and mercilessly exposed by one of the wittiest mathematical innovators of the 19th century" first appeared in book form after De Morgan's death in 1871. Ernest Nagel, in his excellent introduction to the present reprinting, points out that many popular accounts of the developments of modern science tend to "portray the failures, the paradoxers, and the misplaced energies in the history of sciences as if they were invariably the products of foolish ignorance and astonishing incompetence"; that, although the *Budget* "gives ample proof that such paradoxers are indeed frequently undisciplined intellects," nevertheless "it also shows that they are often men with unusual mental powers. . . ." In any event, the failures and the apparent cranks in the quest for knowledge have not all been fools or ignoramuses. And surely there are many attentive readers of the *Budget* who will not be able to repress the comment in connection with some of the figures appearing in it: "There but for the grace of God go I."

DUANE ROLLER

Ramo-Wooldridge Corporation

Handbook of Textile Fibers. Milton Harris, Ed. Harris Research Laboratories, Washington 11, D.C. 1954. xii + 356 pp. Illus. $12.50.

The evolution of fiber science that has taken place during the last few decades has emphasized the need for good reference books to go beyond the framework of conventional chemical, physical, and engineering handbooks. Harris and his staff of able collaborators are to be commended for publishing a handbook that contains, in easily accessible form, important information widely scattered over the textile literature. Thus, it offers a valuable tool to those concerned with the fundamental and engineering aspects of fibers.

Handbook of Textile Fibers is a compilation of physical, chemical, and textile data frequently needed by the fiber technologist, with added information on nomenclature, economics, and fiber identification, as well as selected chemical and engineering tables. It shows some analogies with Kaswell's *Textile Fibers, Yarns and Fabrics,* which was published a few months earlier. However, its scope is somewhat different, and the two books supplement one another.

The data listed are reliable and up to date. Only a few minor flaws were noted, such as an incomplete "List of textile periodicals," a list of "Man-made fibers" that is not completely up to date (although some of the missing items may be found elsewhere in the book), a scarcity of foreign language literature references, and the absence of an author index. (Although it is true that many handbooks do not contain an author index, the value of the Harris book would undoubtedly be increased by an easily accessible reference to key publications.) Also, there are some slight inaccuracies. For instance, data are presented on Orlon without specifying to which of the widely different types they refer (p. 100).

In spite of such minor deficiencies, the new handbook is definitely an important addition to the textile literature. There are few books in the fiber field that contain so much information in so little space.

Handbook of Textile Fibers is well printed and contains a wealth of tabulated data and many well-reproduced illustrations. It can be warmly recommended to all those whose work requires frequent and quick reference to the characteristics and the performance of natural and man-made fibers. It is up to date in all important respects and reflects the research achievements of a generation, compiled and interpreted by the dedicated effort of a group of outstanding contributors.

FRANK J. SODAY

Chemstrand Corporation

Miscellaneous Publications

The Chemical Industry Facts Book. Manufacturing Chemists' Association, Inc., Washington, 1955. 148 pp. $1.

Specification for Dry Cells and Batteries. NBS Circular 559. National Bureau of Standards, Washington 25, 1955 (Order from Supt. of Documents, GPO, Washington 25). 17 pp. $0.25.

The Archeological and Paleontological Salvage Program in the Missouri Basin, 1950–1951. Smithsonian Misc. Collections, vol. 126, No. 2. Paul L. Cooper. The Institution, Washington, 1955. 99 pp.

New York Life Insurance Co. 110th Annual Report, 1954. The Company, New York 10, 1955. 37 pp.

Enemy Way Music. A study of social and esthetic values as seen in Navaho music. Rpt. of Rimrock Project Values Ser. No. 3. David P. McAllester. Peabody Museum, Harvard Univ., Cambridge, 1954. 96 pp. $2.65.

Soil Freezing. Highway Research Bd. Bull. 100. Natl. Acad. of Sciences–Natl. Research Council, Washington 25, 1955. 35 pp. $0.60.

Aprovechamiento de la Energía Atomica. Ser. Monogr. Cientificas. German E. Villar. Div. de Publicaciones, Union Panamericana, Washington, 1955. 66 pp.

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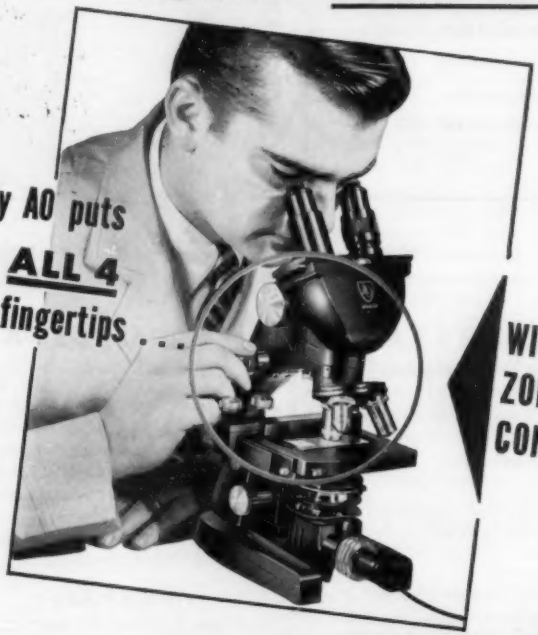

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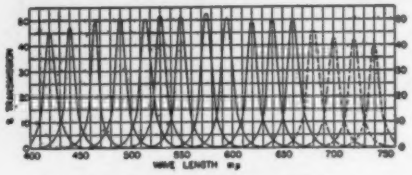

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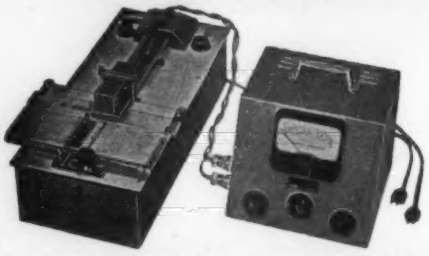

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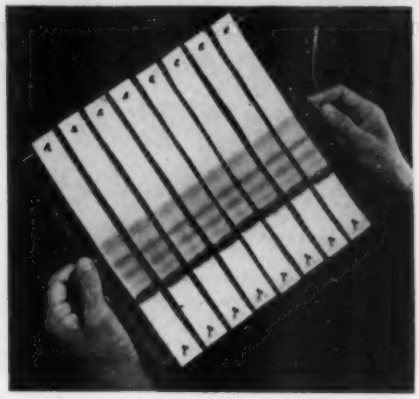

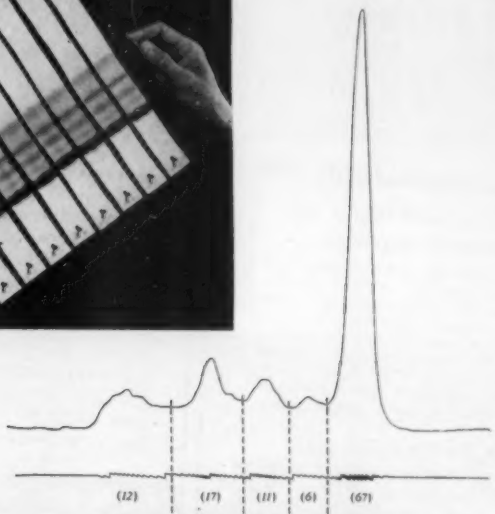

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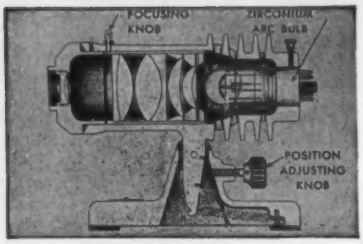

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Advantages of an Atlanta Meeting

The AAAS board of directors has received several communications urging that the 1955 meeting be moved from Atlanta, Georgia, to a city in which segregation laws and customs do not prevail. The board considered these communications at its meeting on 11–12 June and concluded that the advantages of an Atlanta meeting needed clearer statement and wider dissemination than they had been given in 1953 when the decision to hold the 1955 meeting in Atlanta was reached.

In order to advance science and its public understanding, it is desirable that the American Association for the Advancement of Science hold meetings in every part of the country. Atlanta is a center of a region in which the Association has not met since 1913 and in which there has been impressive scientific, technologic, and educational growth.

Because the Association recognizes no distinction of color in the achievement of its purposes, the situation in Atlanta was carefully explored. It was determined that all program sessions, the exhibits, the Science Theater, and the Association's social functions —the Presidential Reception and the Biologists' Smoker—could all be held on a nonsegregated basis. Although all the professional activities are thus nonsegregated, it unfortunately remains true that segregation still obtains in hotels, restaurants, and transportation. The board believes, however, that scientists of all races will benefit from participation in this meeting, and that the advantages outweigh the disadvantages.

The board recognizes the existence of honest differences of opinion regarding the most effective means of reaching a common goal and made its decision to hold a meeting in Atlanta because it believes that the meeting will serve to "improve the effectiveness of science in the promotion of human welfare."

The anthropology section of the Association has decided not to hold any sessions at the Association's 1955 meeting in Atlanta because of the practices of racial segregation in that city. Several individuals and organizations have urged the whole Association not to meet in Atlanta. The decision to meet there was made in 1953 after a most careful study of all of the factors involved, and the board believes that the original reasons are valid.

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Washington, D.C.
12 June 1955

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25–30. International Anatomical Cong., Paris, France. (G. Cordier, 3 Square Alboni, Paris 16e.)

26–29. American Malacological Union, Staten Island, N. Y. (Mrs. M. C. Teskey, P.O. Box 238, Marinette, Wis.)

28–30. Colloquium on Biochemical Problems of Lipids, 2nd, Univ. of Ghent, Belgium. (R. Ruyssen, St. Jansvest 12, University of Ghent, Belgium.)

August

1–5. American Oil Chemists' Soc., short course on analytical techniques, Urbana, Ill. (L. R. Hawkins, 35 E. Wacker Dr., Chicago 1, Ill.)

1–5. International Cong. of Plastic Surgery, Stockholm and Uppsala, Sweden. (J. F. Larsen, 12, Kristianiagade, Copenhagen Ø, Denmark.)

1–6. International Cong. of Biochemistry, Brussels, Belgium. (C. Liebecq, 17 Place Delcour, Liége, Belgium.)

3–7. International Meeting of Neurobiologists, Groningen, Netherlands. (J. A. Kappers, Dept. of Anatomy and Embryology, Oostersingel 69, Groningen.)

5–6. Pennsylvania Academy of Science, University Park, Pa. (K. Dearolf, Public Museum and Art Gallery, Reading, Pa.)

6–7. Linguistic Soc. of America, Washington, D.C. (A. A. Hill, 1719 Massachusetts Ave., NW, Washington, D.C.)

8–10. Inst. of Aeronautical Sciences, Seattle, Wash. (S. P. Johnston, IAS, 2 E. 64 St., New York 21.)

12–17. Canadian Teachers' Federation, Ottawa. (G. G. Croskery, 444 MacLaren St., Ottawa, Ont.)

15–16. Operations Research Soc. of America, 7th national, Los Angeles, Calif. (R. A. Bailey, Military Operations Research Div., Lockheed Aircraft Corp., Burbank.)

15–18. American Veterinary Medical Assoc., Minneapolis, Minn. (J. G. Hardenbergh, 600 S. Michigan Ave., Chicago 5, Ill.)

15–19. American Institute of Electrical Engineers, Pacific general, Butte, Mont. (N. S. Hibshem, 33 W. 39 St., New York 18.)

15–19. American Soc. of Agronomy and the Soil Science Soc. of America, joint meeting, Davis, Calif. (L. G. Monthey, 2702 Monroe St., Madison 5, Wis.)

15–20. International Dental Federation, 43rd annual, Copenhagen, Denmark. (W. R. Klausen, 1 Alhambravey, Copenhagen V.)

17–24. Australian and New Zealand Assoc. for the Advancement of Science, 31st, Melbourne, Australia. (J. R. A. McMillan, ANZAAS, Science House, 157 Gloucester St., Sydney, N.S.W., Australia.)

17–9. Canadian Mathematical Cong., 5th summer seminar, Winnepeg, Manitoba. (Secretariat, CMC, Chemistry Bldg., McGill Univ., Montreal.)

19–28. International Conf. of Agricultural Economists, Helsingfors, Finland. (J. R. Currie, Dartington Hall, Totnes, Devonshire, Eng.)

19–30. National Assoc. of Biology Teachers, Ann Arbor, Mich. (P. V. Webster, Bryan City Schools, Bryan, Ohio.)

22–23. Electronics and Automatic Production Symposium, San Francisco, Calif. (Wm. D. McGuigan, Stanford Research Inst., Palo Alto.)

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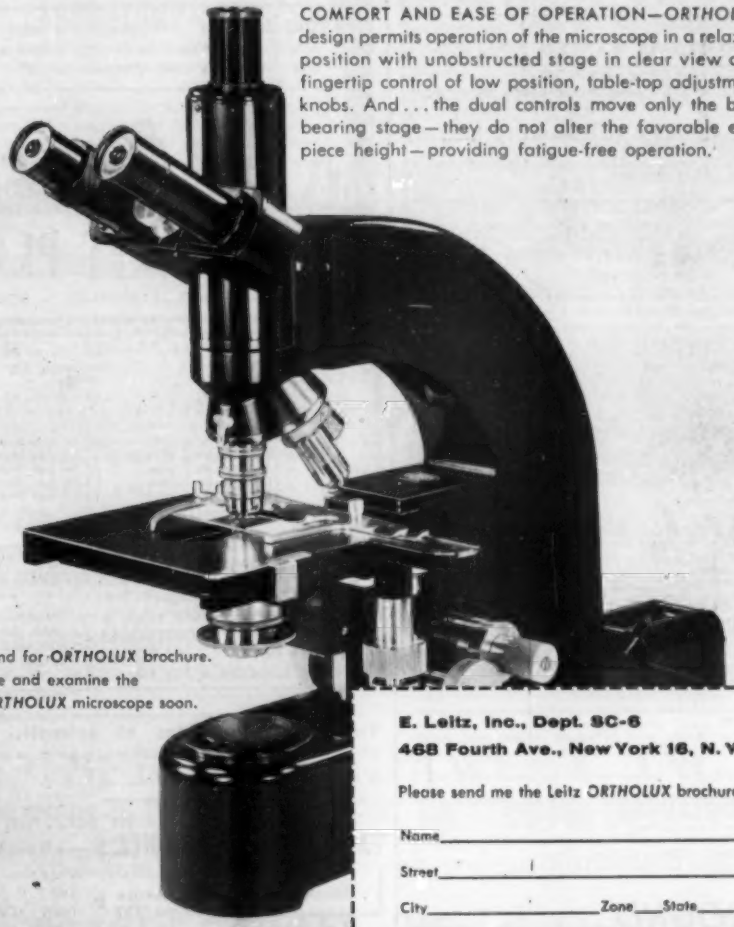

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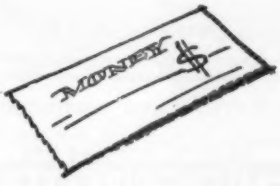

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